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GENERAL INFORMATION

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As a convenience to contributors to RADIOLOGY who are unable to supply prints for their manuscripts, the Editor can arrange for intermediate prints from roentgenograms.

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Roentgen-Ray Diagnosis of Malignant and Potentially Malignant Lesions of the Colon and Rectum

JOSEPH C. BELL, M.D., and JAMES B. DOUGLAS, M.D.

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For MANY YEARS physicians have taught that the only hope of control or cure of cancer and allied malignant lesions lay in early diagnosis and adequate indicated therapy. This teaching is bearing fruit, and the public in general is becoming cancer conscious. In the past, many patients having cancer were first seen by a physician from six months to one year from the onset of symptoms. All too often the lesions were then far advanced and the probability of protracted arrest, or cure, was remote.

Ten years ago we seldom saw a carcinoma of the left half of the colon without a high degree of partial obstruction or even complete obstruction; but during the past three years this rarely has been true. At present it is not at all uncommon for a patient to report for examination with symptoms of less than one month in duration. One such patient, for example, had been perfectly well until one week before our examination, when for twenty-four hours she experienced pain in the left abdomen, after which she was again symptom-free. A well developed annular carcinoma was found in the descending colon at the exact site of the pain. A resection was done and the patient is clinically well at present, two years later.

As is indicated in the preceding paragraph, patients are being seen much earlier in the course of their disease and the difficulties in diagnosis have correspondingly increased. In far-advanced stages of cancer of the colon the diagnosis is usually obvious even after a more or less perfunctory examination by one with little training and limited experience. In the early stages of the same disease, however, the problem of diagnosis is very different and may challenge the ingenuity even of the most highly trained and widely experienced examiner.

Patients are doing their part in reporting early for examination. They are placing themselves in our hands, trusting us to safeguard their future health, and we must not fail them.

Whitehead (1) cites figures compiled by Dublin, of the Metropolitan Insurance Company, showing that 17 per cent of all deaths caused by cancer are traceable to cancer of the colon or rectum. This indicates the seriousness of the problem with which we are dealing. That much can be done to prevent or postpone many of these deaths is indicated by Rankin and Johnston (2) who, in an analysis of 453 operated cases of cancer of the colon, found 52.6 per cent clinically well five years later.

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[1] Prepared for the Thirty-third Annual Meeting of the Radiological Society of North America, Boston, Mass., Nov. 30–Dec. 5, 1947.

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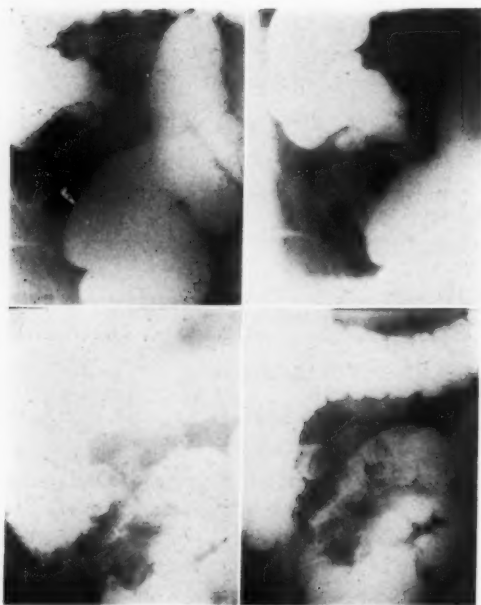
Fig. 1. The two upper illustrations show deformity of the cecum due to carcinoma. The lower views illustrate deformity of the cecum and sigmoid secondary to acute appendicitis with abscess.

Of the group without evidence of lymph node involvement, approximately 25 per cent more were well after five years than among those in whom the nodes had been invaded. This emphasizes the importance of early diagnosis and treatment if we hope to improve our results.

Boehme and Hanson (3), in a review of 1,457 cancers of the large bowel, report that 75 per cent were found in the sigmoid, rectosigmoid, and rectum, approximately 50 per cent being in the rectum. Twenty-five per cent of the series were almost equally distributed throughout the colon proximal to the sigmoid with the exception of the cecum, where slightly more than 6 per cent of the total were found.

It is assumed that before a patient is referred for roentgen examination of the colon a detailed history has been taken, followed by a thorough physical examination, including digital rectal exploration. All too frequently in our experience, however, the pertinent findings are not reported to the radiologist. This does not justify the examiner in proceeding blindly with his roentgen investigation, for a few brief questions may yield much needed information. Listed in what we consider their order of importance, they concern: (1) recent change or absence of change in bowel habits; (2) abdominal discomfort

Fig. 2. Carcinoma of the ascending colon, with marked narrowing of the lumen.

or pain indicating interference with passage of material through the bowel; (3) rectal bleeding, its character, duration, and amount; (4) indigestion; and (5) evidence of progressive anemia. While these questions are being answered, the abdomen may be palpated and obvious intra-abdominal masses thus detected. These preliminaries require little time. They serve to allay apprehension, secure the confidence of the patient, and frequently yield invaluable information.

It is essential that the various types of investigation be logical in sequence and that those first used be the ones most likely to yield the maximum and most accurate information.

Since it is well known that from 65 to 75 per cent of all cancers of the colon and

rectum can be visualized with the sigmoidoscope and biopsy material be secured, when necessary, this then is the next logical step to employ. To be of value the examination must be thorough, carried out by a trained and experienced physician after cleansing of the lower
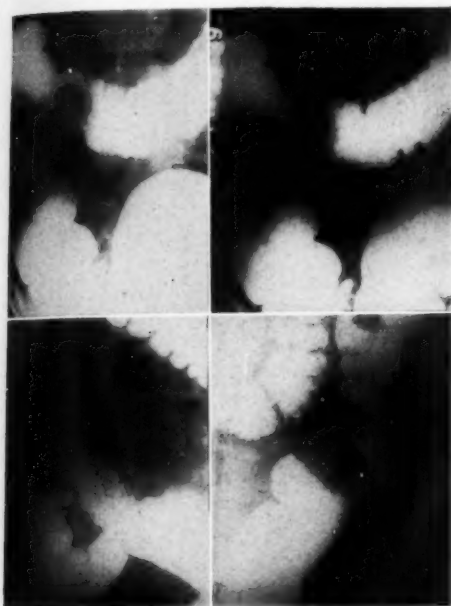
Fig. 3. The upper illustrations show extensive carcinoma of the ascending colon with extension into the transverse portion.

The lower left view shows deformity of the sigmoid. The resected specimen in this case revealed papillary adenoma, considered at the time of resection to be benign but certainly potentially malignant. Exposure made in left postero-anterior oblique projection without grid.

Carcinoma at the junction of the rectum and sigmoid is shown at the lower right. Exposure made in right postero-anterior oblique projection without grid.

bowel, and preferably with the patient in the inverted position. Sigmoidoscopy yields most valuable information not only in detection of cancer when present, but by revealing many other significant lesions, such as polyps, fissures, areas of ulceration in the mucosa, hemorrhoids, etc. It must be borne in mind that interpretation of findings is not entirely free from error and that the value of the procedure varies with the skill, experience, and thoroughness of the examiner.

Fig. 4. Area of narrowing in sigmoid due to spasm, simulating carcinoma. Re-examination showed normal filling with no evidence of disease.

Unfortunately the sigmoidoscopic examination is not as widely and frequently employed as it should be. The radiologist can, by suggestion, do much to promote the proper use of this investigative method. In so doing he shares responsibility in diagnosis, but the end-results are to the advantage of all concerned.

Many writers state that the interpretation of findings following the roentgen examination of the sigmoid, rectosigmoid, and rectum is so inaccurate that it is useless. With this we most vigorously disagree. If the roentgen examination is properly done and the findings are interpreted by a trained and experienced examiner, few cancers in the area under discussion will escape detection.

By a properly done examination we mean one in which the bowel is thoroughly cleansed and, during filling, painstaking roentgenoscopic observations and films are made in all indicated positions. We
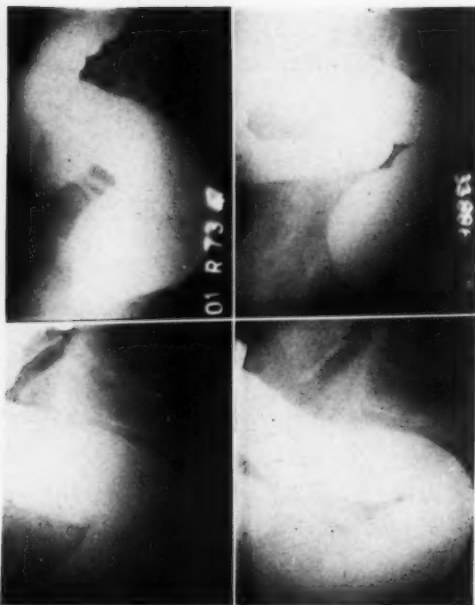
Fig. 5.   Four lateral exposures of rectum in different individuals, made without use of grid, with roentgenoscopic tube, showing normal contour of rectum in lateral projection and its relationship to the sacrum.

obtained films of the rectum and sigmoid in right and left oblique projections, the degree of rotation being determined by fluoroscopic findings, and the exposures made in exactly the same projections. We secure a true lateral projection of the filled rectum and rectosigmoid, after which a film of the entire colon, including the rectum, is made in the postero-anterior projection immediately after filling the colon and again following evacuation.

Our film technic varies somewhat from that generally employed in that we have a three-contact quick change-over switch control attached in parallel with the change-over switching apparatus in the spot-film tunnel. This permits exact duplication on the film of any roentgenoscopic image by placing an 8 × 10 or 10 × 12 cassette over the area of interest, after which the exposure is made. No grid is employed except in films of the entire large bowel, and the quality may be judged by our illustrations.

Serial exposures, often of great value in differentiating a stricture secondary to a diverticulitis from a cancer, are readily secured in this way. Of importance is the fact that the auxiliary switch is in the control booth, and the examiner is thus protected from needless and possibly dangerous radiation.

Fig. 6.   Lateral projection of rectum showing carcinoma of anterior wall.   A lesion of this type can seldom be shown in any other projection and frequently cannot be seen during roentgenoscopy.

We have indicated that we consider the roentgen examination of the rectum and sigmoid to be of real value in the detection of cancer in this region. We are fully aware of its limitations and consider the digital rectal and rectosigmoidoscopic examinations the primary steps in investigation and the roentgen study a secondary one. We emphasize the importance of the roentgen method, however, since our experiences have shown that many cancers will not be discovered until irreparable damage has taken place unless they are detected by the radiologist. We regret that this is true and again cannot too strongly urge that all physicians resort early to proctosigmoidoscopy in the diag-

nosis of the many diseases that manifest themselves in the distal part of the large bowel.

Even when a sigmoidoscopic examination reveals a cancer, a polyp, or one of many other abnormalities, careful roentgen investigation of the entire bowel is
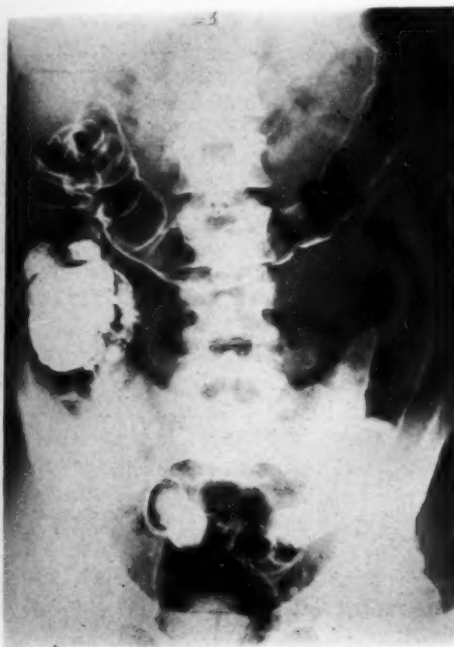
Fig. 7. Double contrast examination of large bowel showing very small sessile polyp in left lateral wall of rectum in profile. Polyps of this size can seldom be visualized except in direct profile. Other parts of the bowel were normal.

Fig. 8. Extensive diffuse polyposis, with very large polyp just distal to the hepatic flexure. The condition was discovered in 1932, when the patient was seen for a routine check-up. In spite of extensive involvement, there were no symptoms. Desiccation of the polyps in the rectum and lower sigmoid, to be followed by resection of the colon proximal to the desiccated areas, was strongly advised but was refused. Ten years later the patient was re-examined and was found to have a definite carcinoma at the anorectal margin, with pulmonary metastases. She died two months later. The illustration shows the condition of the large bowel at the last examination.

usually indicated, for both of the first mentioned conditions may be single or multiple and many of the others may be generalized.

It must be borne in mind that defects due to organic lesions are constant. If there is any question of the nature and significance of a filling defect noted during roentgenoscopy, or on a film, it is essential that the examination be repeated at the earliest possible time, for if significant the defect will again be demonstrable. Only by resorting to indicated re-examinations can serious errors in diagnosis be avoided.

Cleansing of the bowel may not be the

simple task that it would seem. It is of the utmost importance in the demonstration of polyps by the so-called double-contrast method of examination, for these may be exactly s'mulated by fecal masses. Fecal masses are less likely to be mistaken for carcinomas but, in case there is any doubt, the bowel should be thoroughly cleansed and re-examined.

We have found no substitute for castor oil and use 1 1/2 to 2 ounces before the evening meal the night prior to the x-ray examination. The noon and evening meals should be of the low residue type. The morning of the examination the distal part of the colon and rectum are cleansed by

Fig. 9.   Relatively small sessile polyp of the sigmoid as shown in right postero-anterior projection.

means of a warm tap-water enema.   At times the foregoing routine is not sufficient and in a few instances it has been necessary to place the patient on a low residue diet and to give castor oil in the above dosage two consecutive nights prior to examination.

The double-contrast examination of the large bowel is a valuable adjunct in diagnosis.   Its major field of usefulness is in the demonstration of polyps, where it is reasonably accurate providing the polyps are of moderate size or numerous.   It is rarely needed for the demonstration of cancers but may at times be of aid, especially in some early lesions and some in the right side of the colon.   Unless circumstances are unusual, we refuse to do an ordinary barium enema study and then immediately follow it by a double-contrast enema.   The two procedures require entirely different technics and, if they are combined, neither is likely to be satisfactory.   The first requires complete filling of the colon with an aqueous suspension of

approximately 180 c.c. of barium sulfate in 2 quarts of warm tap water.   For the double-contrast examination we use the same volume of barium sulfate but in one-half the volume of water.   The injection is continued only until the column reaches the mid-transverse portion, after which the opaque suspension is expelled as promptly as possible and the bowel is then moderately distended with air.   Stereoscopic films of the entire large bowel are made in the prone and right postero-anterior oblique positions, after which the gas is expelled.   At times films are made after partial evacuation of the gas, but not routinely.   Usually the lumen of the entire colon is well outlined, and many polypoid lesions have been demonstrated in the right side and transverse portions as well as in the distal half of the bowel.

Polyps of the large bowel are now considered potentially malignant by all authorities, and in the presence of diffuse polyposis there is little probability that the individual will live beyond early or mid-adult life without malignant change developing in one or more of the polyps. With a single polyp, or a very few, there are correspondingly fewer potential sources of malignant change, but this in no way alters the serious import even of a single such lesion.   When few in number, or single, and within reach of the sigmoidoscope, polyps can be cauterized and destroyed with relative safety; when they are diffuse, much more radical procedures are indicated.

The sigmoidoscopic examination is the most accurate method for demonstrating polyps in the rectum and distal sigmoid, and only by the closest co-operation between the proctologist and the radiologist can accurate diagnostic information be obtained.   When even a single polyp is discovered by sigmoidoscopy a double-contrast examination of the entire colon should be done, for there may be, and frequently are, other demonstrable lesions of a similar nature above the area that can be examined with the sigmoidoscope.

It is essential that all physicians recog-
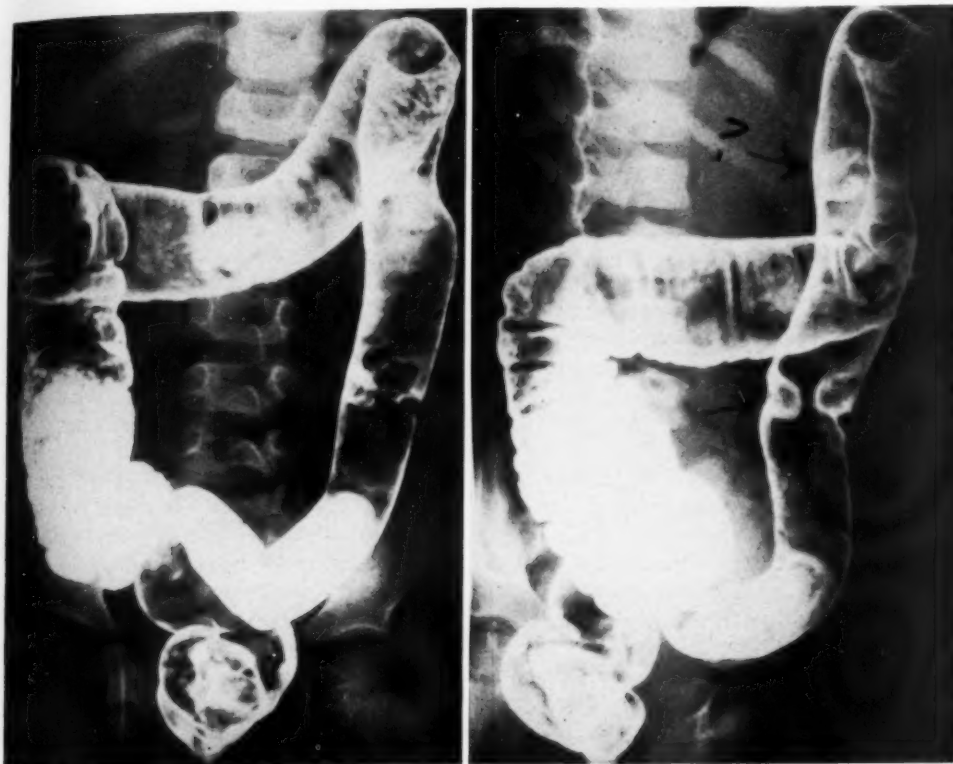
Fig. 10.   Double-contrast study of large bowel: postero-anterior and right postero-anterior oblique projections. Two large sessile polyps of the descending colon in a child, with persistent hemorrhage from the bowel.   A third shadow just distal to the splenic flexure, indicated by the arrow with a question mark, is undoubtedly due to another large polyp.

nize the limitations of the roentgen examination in the demonstration of polyps. The standard barium enema is of no value except in a few instances where polyps are very numerous or large, or, at times, in the demonstration of malignant changes in polyps, especially where there has been extension into the bowel wall. The double-contrast method is not highly accurate and is beset with many difficulties and possible sources of error even in the hands of the most painstaking, the most highly trained, and most experienced examiner.   It is valuable, however, when its virtues and limitations are recognized.

COMMENT

Cancer of the colon and rectum can be controlled or totally eradicated only if dis-covered early and treated appropriately. In the analysis of a large series of cases it has been found that slightly more than 50 per cent of those with lesions proved to be operable are living and free from demonstrable cancer at the end of five years.   If the diagnosis can be made before lymph node involvement takes place, we can anticipate an increase of at least 10 per cent in those well at the end of five years.   In cancer of what other organ can better results be shown?

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SUMARIO

Diagnóstico Roentgenológico de las Lesiones Malignas y Potencialmente Malignas del Colon y el Recto

El examen roentgenológico del colon debe ir precedido de: (1) un interrogatorio adecuado con referencia particular a los hábitos intestinales, malestar o dolor abdominal, proctorragia e indigestión o signos de anemia progresiva; (2) exploración digital del recto; (3) sigmoidoscopia, la cual revelará de 65 a 70 por ciento de todos los cánceres del colon y recto.

Aunque supeditado a la exploración digital y la sigmoidoscopia, el examen radiográfico debidamente ejecutado e interpretado constituye un importante auxiliar diagnóstico, exigiendo una limpieza esmerada del intestino y minuciosas observaciones roentgenoscópicas durante la repleción del intestino. Obtiénense radiografías del recto y la S iliaca en proyecciones oblicuas derecha e izquierda y lateral verdadera, e inmediatamente después del henchimiento y de nuevo después de la evacuación se hace una radiografía anteroposterior de todo el colony y el recto.

El método de examen de doble contraste resulta de valor especial para el hallazgo de pólipos, pero probablemente no dará resultado satisfactorio si se realiza junto con el estudio habitual con bario, por exigir una técnica distinta.

Recálcase la importancia del re-examen en los casos dudosos y se hace de nuevo hincapié en las potencialidades malignas de los pólipos del intestino grueso.

De los enfermos con cáncer operable del colon y recto poco más de 50 por ciento se hallan vivos y clínicamente bien al cabo de cinco años. Si el diagnóstico se hace antes de tener lugar la invasión ganglionar, cabe esperar un aumento por lo menos de 10 por ciento en dicha cifra.

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The Mucosal Pattern of the Terminal Ileum in Children

Preliminary Report[1]

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THE MUCOSAL pattern of the barium-filled normal terminal ileum under

Fig. 1.   Normal adult terminal ileum under pressure.

pressure in the adult appears as slender regular lines (Fig. 1) produced by the mucosal folds (Golden, 1). These folds may run either longitudinally or transversely. Referring to adults, Golden commented on the fact that the lymphoid cell collections in the mucous membrane do not produce a recognizable effect on the barium shadow.

The mucosal pattern of the terminal ileum in children has been found to differ from that of adults.   The purpose of this pa-
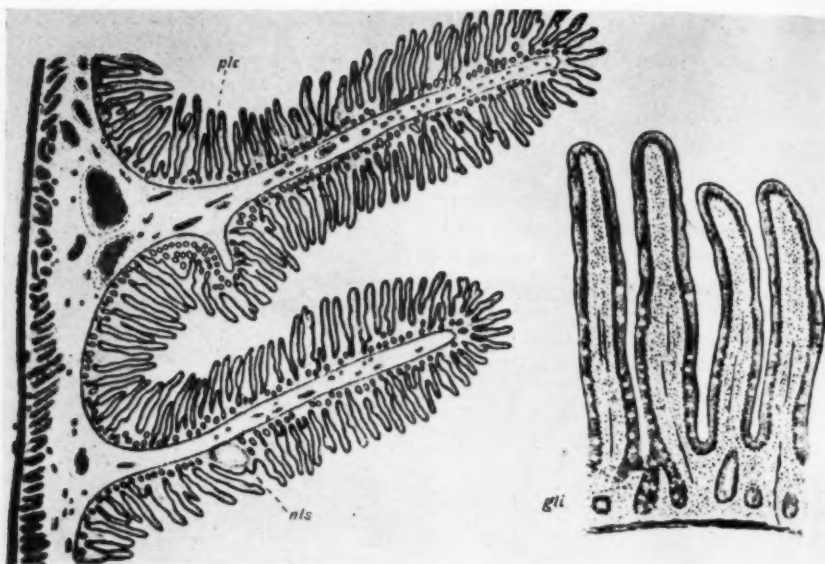
Fig. 2. Section through normal jejunum. To the left is a low-power view of the whole jejunal wall. To the right is a section under high-power magnification. *nls*. Mucosal lymphoid cell collection. *plc*. Valvulae conniventes. (Sobotta)

per is to present evidence showing that this difference is produced by the relatively larger and more prominent normal lymphoid cell collections in children and that it is not abnormal.

ANATOMY

The wall of the normal small intestine is composed of four coats, the serosa, tunica muscularis, submucosa, and mucosa (Fig. 2). The tunica muscularis consists of an outer longitudinal and inner circular layer. The submucosa consists of connective tissue, blood vessels, and lymph vessels. The mucosa is composed of the muscularis mucosa, the tunica propria, and the epithelium. The mucosal folds (valvulae conniventes) are much higher and more numerous in the jejunum than in the ileum. These produce the mucosal pattern seen in barium studies.

Small lymph nodes are present in the mucosa and submucosa; the apex of these solitary lymphatic nodes forms a dome-like elevation of the surface of the mucous membrane. They are more numerous and higher in the ileum and may coalesce to form conglomerate groups of 20 to 30 nodules, commonly called Peyer's patches; these may be as much as 10 cm. in length (2). With increasing age, after puberty, the lymphoid tissue in the intestine, as well as that elsewhere in the body, is reduced in quantity (3).

ROENTGEN OBSERVATIONS

In routine gastro-intestinal studies on children under thirteen years of age, in the Babies Hospital (New York), it was noted that the terminal ileal pattern was different from that seen in adults. Small, rounded filling defects rather than slender, regular lines were found when pressure films were made. Since the patients in which these observations were made were examined because of abdominal complaints, it was decided to examine asymptomatic children as a further check on the roentgenographic appearance of the ileum.

Studies were accordingly made on 14 hospitalized children, none of whom had abdominal complaints or was seriously ill. These patients were given barium sulfate in the morning on a fasting stomach. In

9 cases the barium was suspended in tap water; in the remaining 5 the suspension was made with normal saline, with distilled water, to rule out a possible response to an allergen. The patients were examined by fluoroscopy about two hours and a half later, and at intervals thereafter until the terminal ileum was filled. If the terminal ileum was not filled with barium after four hours, the patient was allowed to have food. In all cases small, round, or oval translucent areas were demonstrated in the barium-filled terminal ileum, which gave a cobblestone appearance (Fig. 3). None of the children had a palpable or tender terminal ileum.

As stated above, the most marked anatomic change which takes place in the terminal ileum after puberty, with advancing age, is a reduction in the size of the aggregations of lymphoid tissue in the mucosa and submucosa. No other changes have been described which would be likely to cause a difference in the mucosal pattern of adults and children in the absence of disease. It is postulated, therefore, that the cobblestone appearance in the barium-filled terminal ileum in children is caused by normal lymphoid follicles.

A well developed, well nourished eleven-month-old child died twelve hours after the onset of acute laryngotracheobronchitis. At autopsy, the lymphoid cell collections in the terminal ileum were numerous and produced rounded projections above the level of the surrounding mucosa. These nodules were interpreted by the pathologists at the Babies Hospital as normal for a well nourished child without illness relating to this area. Barium was smeared on the mucosal surface of this terminal ileum, and roentgen films were taken, which show that the lymphoid cell collections produced the cobblestone appearance described above (Fig. 4).

At necropsy after chronic illness with wasting, the usual, normal amount of lymphoid tissue is decreased in infants. A roentgenographic examination was not done under these conditions. It seems probable that such an examination might
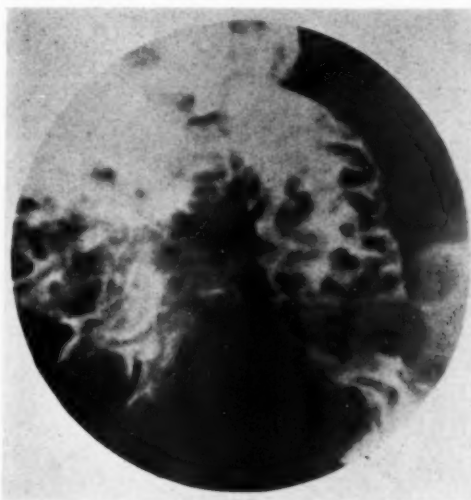
Fig. 3. Terminal ileum of nine-year-old girl with no gastro-intestinal symptoms or signs and no general lymph-node enlargement. Note rounded filling defects.

show a mucosal pattern similar to that of the adult ileum.

Golden (1) described a similar cobblestone configuration associated with a palpable tender ileum in a number of patients with right lower quadrant pain. He thought that this appearance was the result of thickening and abnormality of the mucosal folds and attributed it to inflammation. All of the patients were under thirty years of age. The appendix of one of them, a thirteen-year-old girl, was removed. At operation the surgeon thought that the ileal wall appeared slightly thickened on palpation; the appearance of the serosal surface was normal, and the ileum was not opened or resected; mesenteric lymphadenitis was present. A nurse, aged twenty-four, was found at operation for appendicitis to have a thickened terminal ileum and mesenteric lymphadenitis; the appendix was normal. Roentgen examination after the operation disclosed irritability of the terminal ileum with a mucosal pattern similar to that described above. Six months later, after medical treatment, the mucosal pattern was normal. None of the patients seen at the Presbyterian Hospital with the cobblestone ileum as-
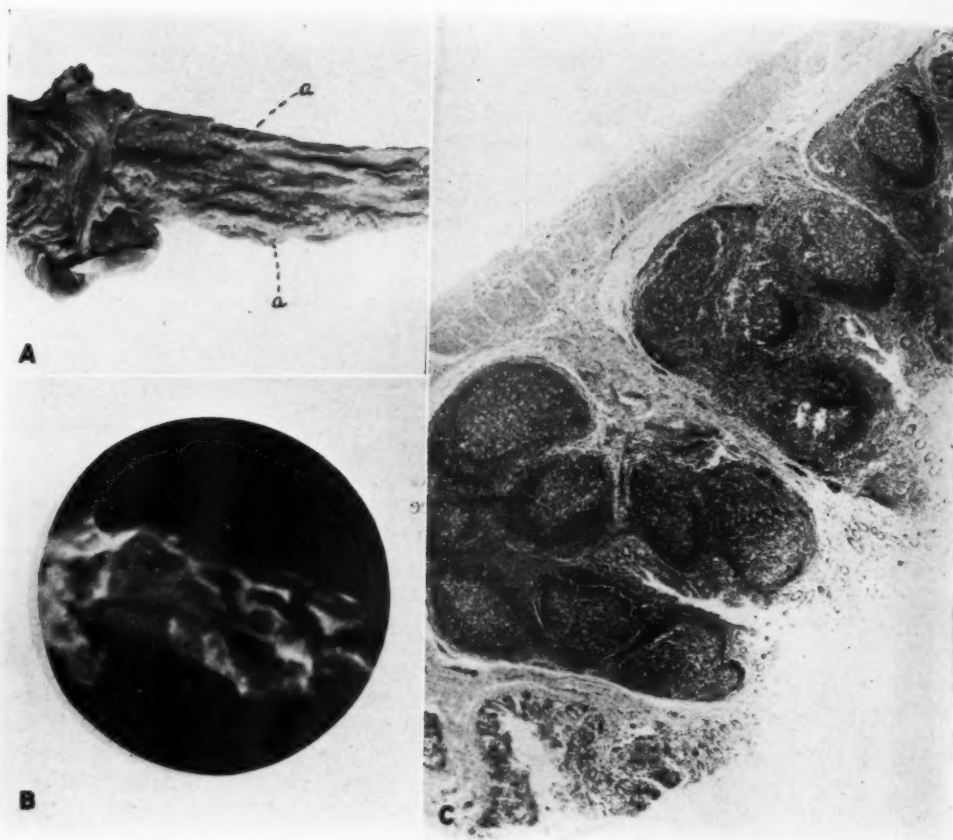
Fig. 4. A. Autopsy specimen of terminal ileum and cecum of eleven-month-old child with no gastro-intestinal
symptoms or signs. Note elevations at *a*, due to normal lymphoid tissue.
B. Film of specimen shown in A, after smearing with barium.
C. Low-power photomicrograph of same specimen, showing collections of lymphoid cells.

sociated with right lower quadrant pain
has had a resection, and in none has typical
sclerosing regional enteritis developed.

Rockey (6) described 4 cases in which
children were operated upon for appendi-
citis and a normal appendix with thicken-
ing of the wall of the terminal ileum and
mesenteric lymphadenitis was found, but
no resections were done. In one case he
commented that the thickening seemed to
be in the mucosa and submucosa.

Further observations are required to es-
tablish the approximate age range at which
the normally large lymphoid cell collections
in the terminal ileum of children become
sufficiently reduced in size so that the

cobblestone appearance will not be pro-
duced.

SUMMARY

The mucosal pattern of the terminal
ileum in symptom-free children, as demon-
strated by a barium examination, is differ-
ent from that seen in most adults. The
cobblestone appearance of the terminal
ileum of children can be caused by aggre-
gations of normal lymphoid tissue in the
mucous membrane. This picture by
itself cannot be taken as evidence of dis-
ease of the terminal ileum in children. The
approximate age at which this pattern

is no longer demonstrable in the normal ileum is not yet established.

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SUMARIO

Patrón de la Mucosa del Ileon Terminal en los Niños.   Comunicación Preliminar

El patrón de la mucosa de la porción terminal del ileon en niños asintomáticos, según revela un examen con bario, es distinto del observado en los adultos. En vez de las delgadas líneas regulares observadas en los últimos, el aspecto es como de cantos rodados, lo cual, según parece, puede ser debido a agregaciones de tejido linfoideo normal en la mucosa. Por sí solo, este aspecto no puede considerarse como signo patológico en los niños. No se ha establecido todavía la edad a la cual ya no se puede observar el mismo en el ileon normal.

Acute Small Intestinal Obstruction[1]

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THE LITERATURE abounds in the description and discussion of acute small intestinal obstruction. The entity is well known; its cure is absolute; yet the mortality continues to be high. It is this entity into five phases: (1) speedy and accurate diagnosis; (2) decompression; (3) restoration of physiological equilibrium; (4) surgery; (5) postoperative management.
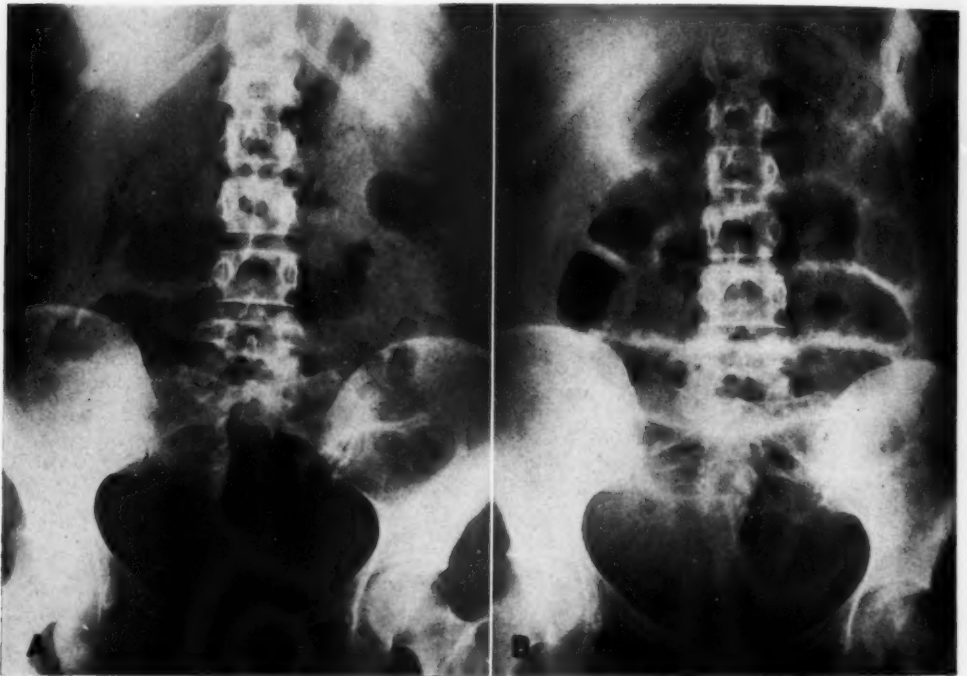
Fig. 1.   A.   Roentgenogram of abdomen at 4 A.M.   B.   Roentgenogram at 7 A.M. showing increased distention.

our purpose to emphasize this condition as a surgical and radiological emergency.

In an analysis of 100 consecutive cases of acute small intestinal obstruction, it was found to be fatal in 15 instances. Except for one case, all should have been saved. Death was due to procrastination on the part of the patient or on the part of the attending physician.

We have divided the management of

SPEEDY AND ACCURATE DIAGNOSIS

In all of our cases of small bowel obstruction, the cardinal symptoms of intestinal colic and vomiting were present. By intestinal colic we mean the concomitant occurrence of borborygmi at the acme of the pain. Abdominal distention was present in most of these cases, although it is admittedly desirable to establish the

diagnosis and institute treatment before this occurs. Any patient who presents these symptoms must be considered to have intestinal obstruction, and it is imperative that a plain film of the abdomen be obtained immediately (Fig. 1).

It was early in the twentieth century that Schwarz in Vienna and Case in America advocated the use of x-rays in the

Fig. 3. Postoperative paralytic ileus. Note gas in cecum, colon, and rectal pouch.

Fig. 2. Advanced small intestinal obstruction, showing "step-ladder" effect and transverse coils.

diagnosis of acute small bowel obstruction. A roentgenogram of the abdomen can give not only the site and degree of obstruction but often furnishes information regarding the type. Many writers, including Wangensteen (1, 8, 12), Pendergrass (13), Sante (6), and Golden (17), have described the characteristic gas patterns in adynamic ileus and mechanical obstruction. Oppenheimer (9) and Wangensteen (1) have ably discussed the roentgen characteristics of acute transient intestinal atony and spastic ileus. We feel that the location, severity, type, and duration of obstruction can be ascertained from a plain

film of the abdomen. When the roentgenogram indicates gas in the small intestine, one must immediately decide whether the gas is present on the basis of an adynamic ileus or actual mechanical obstruction.

The picture of mechanical obstruction is one in which a loop or loops of gut are distended with gas. The degree of distention is dependent upon the site of the lesion and the duration and degree of obstruction. Should the lesion be of recent origin, only an isolated segment or segments of bowel will show distention until it reaches a point where multiple coils of small bowel assume a transverse position in the abdominal cavity (Fig. 2). The portion of bowel distal to the obstruction may remain relatively free from gas.

The picture of ileus (Fig. 3), on the other hand, is one where the gas lies in multiple pockets. It gives the impression that the gas "stops where it may." It may progress to a point where the gas becomes so abundant that the coils of intestine may

Fig. 4.　Early acute small intestinal obstruction.
Fig. 5.　Single loop obstruction showing loss of normal anatomical pattern.

assume a transverse position in the abdominal cavity. However, the colon contains varying amounts of gas throughout its entire length, as does the stomach.

With the earliest roentgen sign of acute small intestinal obstruction—that is, a single loop of bowel distended with gas (Fig. 4)—and a clinical story of obstruction, we believe the "green light" is given for immediate surgery. A single loop obstruction is of importance from another aspect (Fig. 5). It may mean that the blood supply to a segment of gut is embarrassed if the normal anatomical markings are not clearly defined. The valvulae conniventes are present throughout the small intestine; they are more prominent in the upper small gut, being most pronounced in the jejunum. When gangrene occurs, the bowel quickly loses tone and becomes edematous and blackened; its physiological pattern rapidly disappears, and it becomes a smooth-walled tube distended with gas. This is a pathognomonic roentgenological sign of gangrene

or embarrassment of blood supply. There is another sign that can be of definite value in making the diagnosis of gangrene which has to do with the geometrical pattern of the gut (Fig. 6). Single or multiple "C-shaped" loops of small bowel arising from a common source or pedicle always indicate a volvulus. This pattern is accompanied by a loss of the valvulae conniventes, the extent of which is proportionate to the degree of embarrassment of the blood supply. In no case should we correlate the degree of distention seen on a roentgenogram with the severity of symptoms.

Rendich and Harrington (19) have described the findings in the relatively uncommon superior mesenteric thrombosis. Our series includes but one example of this entity, but we can completely corroborate their observations. The syndrome is an extremely dramatic and fulminating one, running its clinical course in but a few hours. The plain roentgenogram of the abdomen in our case showed distention of the whole small bowel as well as the right

half of the colon and, although symptoms had been present only a few hours, the segments already showed some loss of the normal anatomical markings of the ileum.

All laboratory studies in acute small bowel obstruction are of little avail. Only 7 per cent of our cases showed depletion of the blood chlorides. The white count was moderately elevated in 32 per cent; dehydration undoubtedly played a part; leukocytosis is prominent in individuals having impairment of the blood supply, often showing a preponderance of toxic and immature neutrophil forms. A highly elevated white blood count is presumptive evidence of gangrene or inflammation or both.

A typical example of gangrene of the small bowel was found in a twelve-year-old white girl who was admitted to Research Hospital with intermittent abdominal cramps of four days duration. She described them as colicky in type, reaching a peak and then receding. They were generalized throughout the abdomen. The bowel movements were normal, with no blood or mucus in the stools. Twenty-four hours prior to examination the patient began to vomit a greenish, thin material. Her abdomen became more distended and the episodes of vomiting increased; she was in acute abdominal distress. The skin and tongue were not particularly dry. The abdomen was markedly tender and distended, with rigidity on the right side. One could not detect visible peristaltic waves but auscultation revealed some activity of the bowel. There was a right lower quadrant incision, well healed, the result of a Meckel's diverticulectomy five months previously. The temperature was 100.8°, and the pulse 132, weak and thready. The blood pressure was 80/60.

Laboratory studies showed the non-protein nitrogen and blood chlorides to be within normal limits. Of considerable importance was the white cell count of 14,000, with 96 per cent polymorphonuclears, of which 40 per cent were immature and toxic forms, indicating a high degree of toxemia. Morphine sulfate, gr. 1/6, failed to relieve the pain.

The roentgenogram of the abdomen (Fig. 7) shows multiple loops of intestine distended with gas. The upper one shows normal anatomical markings; the lower loops on the right side show a loss of the valvulae conniventes as well as multiple "C-shaped" loops arising from a common source. The diagnosis of an acute small intestinal obstruction with embarrassment of the blood supply due to volvulus was made. Many authors, including Wangensteen (1), Abbott (14), and Metheny and Hartzell (4) have described the syndrome of gangrenous bowel.
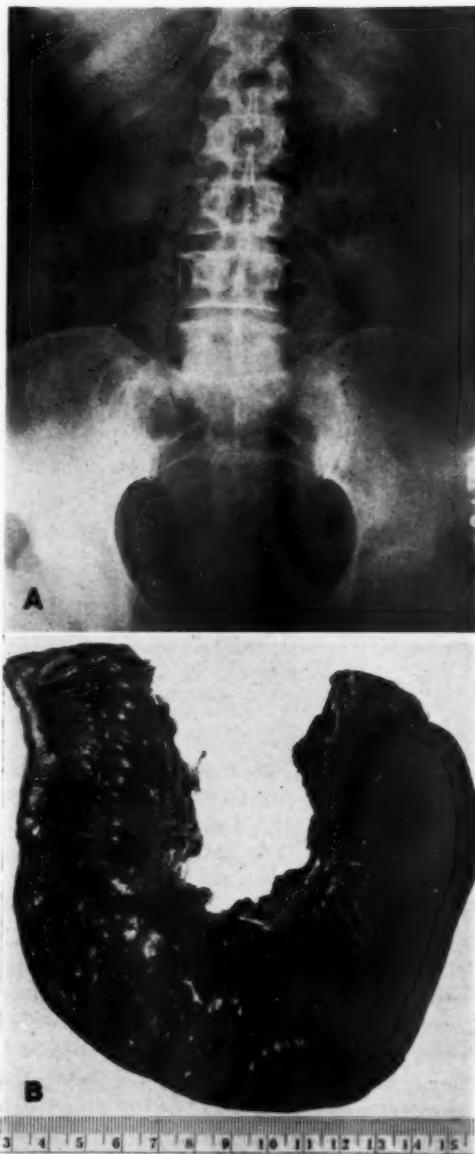

Fig. 6.   A.   Absence of valvulae conniventes in small loop to right of spine.   B.   Specimen of gangrenous bowel.

The child was operated upon immediately; 140 cm. of ileum was resected and an ileostomy established. The abdomen was filled with a bloody fluid and despite all the antibiotics, death occurred seven days later.

Fig. 7. Roentgenogram showing characteristics of impairment of blood supply.

This case illustrates a far-advanced acute small intestinal obstruction in which most of the important signs and symptoms are shown. In the first place, the complete triad of vomiting, pain, and distention was present. The pain of intestinal obstruction is colicky in type, reaching a maximum intensity and then receding. All of the clinical signs of impairment of the blood supply were also present. Opiates failed to relieve the symptoms temporarily and local pain and rigidity on the involved side developed, both signs of peritoneal irritation. The pulse elevated out of all proportion to the temperature and the lowered blood pressure indicate an early picture of shock.

We have found in our analysis that a shock-like picture, leukocytosis, and severe pain with rigidity in the individual showing a loop or loops of small bowel distended with gas suggest that the blood supply is in jeopardy. Leukocytosis, *per se*, does not mean intestinal obstruction but it very often suggests the probability of necrosis and inflammation within the abdomen. Dehydration will cause leukocytosis. Toxemia of intestinal obstruction reflects itself very often in leukogenesis, and a preponderance of toxic forms suggests necrosis of the bowel.

In this case there was a long delay between the onset of symptoms and the diagnosis. Death of the patient resulted. The procrastination here was on the part of the parents, but all too often the delay has been on the part of the attending physician. Intestinal obstruction is an absolute surgical and radiological emergency. Pain, abdominal distention, and vomiting always indicate a scout roentgenogram of the abdomen.

Our department considers roentgenography of the abdomen as an absolute emergency, day or night. When the outcome of such an examination indicates small bowel obstruction, the patient is operated upon immediately unless so much distention is present or the physiology is altered to such an extent that surgery is not deemed wise. In the latter event, decompression must be carried out. A presumptive diagnosis of embarrassment of blood supply always means immediate surgery.

DECOMPRESSION

This phase of treatment can be a powerful adjunct to definitive surgery or can be the doom of the patient. It is logical that the patient who presents either the clinical or roentgen picture of distention needs decompression; to avoid the phase of distention, early operation is imperative. We feel that immediate surgery is indicated in all types of loop obstruction, whether it be from embarrassment of blood supply or simple extraneous involvement.

If the picture is one of distention, and particularly if the patient is in a state of chemical imbalance, decompression is indicated. However, one must be absolutely sure that the vitality of the gut is not endangered.

The type of decompression is an age-old controversy. We feel that there is only

one type—the use of the Miller-Abbott tube. Many authors have condemned this method on the basis of failure of passage of the tube and the length of time required. It has been condemned, also, as giving the surgeon a false sense of security. We use the Miller-Abbott tube only as an adjunct in the treatment of mechanical obstruction of the bowel; surgery is the only way this condition can be corrected. As soon as decompression is complete and the physiology of the patient is restored, in all of our cases operation is performed.

In our experience, the patient who is subjected to ileostomy or cecostomy usually has a stormy time. In two of our cases in which these operative procedures were carried out as a means of decompression death resulted. In the 100 cases of intestinal obstruction, the Miller-Abbott tube was used successfully 39 times, with a single failure, in a moribund patient who died less than twenty-four hours after admission.

It is well to emphasize again this point, that no type of intestinal intubation or decompression need be used if an early diagnosis is established and definite surgery can be carried out without undue risk to the patient. It is also well to emphasize that no case should ever be intubated if the blood supply of the gut is in jeopardy.

The technic of passing the double lumen tube should be handled by the department of radiology. With a certain amount of skill in manipulation under the fluoroscope, and more patience than skill, the Miller-Abbott tube can be passed in a large majority of cases. The tube is inspected to see that the lumina are patent; the rubber balloon is carefully attached in the proper manner; the tube and balloon are again inspected to make sure that the balloon not only holds its contents but that it may be deflated within the bowel should necessity demand. After these preliminaries, the tube is lubricated and with the balloon deflated is passed through the nasal passage into the stomach. Under fluoroscopic control, the tube is advanced into the pyloric end of the stomach. If the patient is of the hypersensitive or gagging type, we feel that 1 to 4 gr. of sodium phenobarbital, intravenously, is efficacious in diminishing the gag reflex. The depressant action of the barbiturates on the gut is not as marked as that of opiates. Atropine sulfate, gr. $1/150$–$1/75$, may be given by hypodermic injection to relieve any spasm or hypertonicity in the pyloric or prepyloric regions. If the patient has a marked gag reflex, anesthetization of the oropharynx with 2 per cent pontocaine may be done.

The difficulty in getting the Miller-Abbott tube to the distal portion of the stomach arises from several factors: first, the extrinsic pressure of the inflated loops of intestine on the stomach; second, the anatomic variation of the esophagus which makes an angle with the stomach, pointing the tube into the cardia instead of the pylorus; third, a high duodenal fixation and acute angulation of the gut just beyond the duodenal cap, necessitating a sharp kink before the tube may get down to the second portion of the duodenum.

In most technics (2, 3, 4, 10) it is specified that the balloon is not to be inflated until the second portion of the duodenum is reached. We are not in agreement with this. As soon as the tip of the tube is in the distal portion of the stomach, the balloon is inflated. One may use water, air, or both, a total of 25–30 c.c. Many reports in the literature suggest the employment of metallic mercury, which we have been using of late to some extent. A thin suspension of barium may also be used, this medium allowing for the study of peristaltic action on the balloon.

Every attempt should be made to keep the patient comfortable on the fluoroscopic table. The tube should be manipulated as gently as possible and in the course of manipulation the patient should be turned on his right side to obtain the full effect of gravity. We have found that inflating the stomach with air is often helpful in allowing the tube to pass smoothly down the greater curvature to the pylorus. The stomach may then be deflated. Careful

observation of the barium-filled bag may demonstrate peristalsis. The patient is allowed to remain on his right side, with gentle and continuous pressure on the tube through the nostril.

Just one word of caution: Remember, we are dealing with x-rays. In the stubborn case, the time during which the patient is exposed to the rays may be prolonged. It is possible that he may be seriously injured in the process of a seemingly innocuous procedure. The fluoroscope should be used sparingly and as discriminately as possible, since there is no way of knowing how much time will be required to pass the tube.

The actual passage of the tube through the pylorus down the gut is dependent on the degree of peristalsis. In the near-moribund patient, this mechanism is often markedly impaired and its re-establishment is necessary for successful decompression. We have found that the administration of sodium chloride through the tube into the prepyloric area of the stomach very often will stimulate peristaltic action. This procedure should be handled with a good deal of caution and should not be resorted to if there is any appreciable peristalsis present. It is absolutely contraindicated if one is not sure that the tube is in a position to decompress the gut. We have seen a violent response to saline in some patients.

The rapidity with which the tube travels down the small bowel varies. In cases of active or hyperactive peristalsis the speed is appalling and, unless one is careful, it is possible that a loop of bowel may be passed without decompression. This always happens where there is inconstant or inadequate suction. Should this occur, it is always possible to deflate the balloon and draw up a small portion of the tube to allow for decompression of the "missed" segment.

After one feels reasonably sure that the tube is on its way down, the patient is put to bed and parenteral fluids are started to re-establish and maintain fluid balance. Constant suction is instituted. Frequent irrigation of the tube is essential and it is necessary to feed the tube periodically through the nostril as it is being dragged along by peristalsis. Too much emphasis cannot be placed upon intelligent, diligent, and conscientious nursing care. The type of material aspirated by the tube is often so thick that mechanical suction may fail.

The reaction to decompression is what one would expect, that is, the subsiding of nausea, vomiting, and pain. The patient sometimes gets a false sense of security when his symptoms are relieved and he cannot see any reason why surgery should be done. This may be noted as early as one to two hours after the tube has entered the duodenum, and in ten to twelve hours the entire clinical picture has improved.

Many of our patients have gone to surgery with the tube in place. This is a safeguard against the possibility of postoperative ileus. If the tube hampers the surgeon, he may withdraw it as much as he desires. When the tube is anchored, it is best to deflate the balloon and allow the tube to remain a number of days in the gastro-intestinal tract. Many of our patients have gone seven to ten days with the tube in place and in one it was left for twenty-four days. Kaufman, Serpico and Mersheimer (22) have mentioned the possibility of a chondritis of the laryngeal and perilaryngeal areas from irritation by the tube. To date we have not seen this phenomenon but believe that it is a definite possibility to be kept in mind. In the case of prolonged intubation, the patient may be given a soft diet, the amount of gut proximal to the end of the tube being sufficient to allow for adequate absorption of food.

During the entire interval that the Miller-Abbott tube is in place, serial roentgenograms of the abdomen are taken. Adequate fluid balance should be maintained. One must remember that fluid and electrolytes are constantly being lost as long as suction is in force. The result will be an increased fluid and salt need as compared to the normal requirements.

Before removing the Miller-Abbott tube,

negative pressure is discontinued for twenty-four hours to make sure the obstruction is fully relieved. If there is sufficient clinical evidence to substantiate the relief of obstruction, one may neglect this step, though it is well to have a roentgenogram before doing so. The act of removing the tube should be done slowly, and one must be sure that the bulb is deflated. We make it a rule to require some twenty to twenty-five minutes to withdraw the tube, feeling that there is less damage to the mucosa of the gastro-intestinal tract than with rapid withdrawal.

RESTORATION OF THE PHYSIOLOGICAL STATE

Electrolyte balance of the patient has been emphasized again and again since the work of Hayden, Orr, and others. Intelligent management requires a knowledge not only of the chloride levels but also the level of the non-protein nitrogen and, particularly in the aged, of the serum proteins. Whole blood and plasma, preoperatively and postoperatively were used repeatedly in the 100 cases reported here to re-establish protein and electrolyte balance.

Without a knowledge of the chemical status, the over-zealous surgeon often drowns his patients in an attempt to restore the electrolyte balance that he believes is lacking. The chloride level in our series varied from 280 mg. per cent to 680 mg. per cent. Needless to say, in the latter case edema and cardiac complications developed as a result of parenteral intake, up to 6,000 c.c. This was immediately relieved by digitalis and reduction of fluids.

SURGERY

It is not within the scope of this paper to discuss the technical aspects of surgery. It is obvious that operation is directed to the removal of the cause of obstruction. In our series, postoperative adhesions was by far the commonest cause. This is not in line with McIver's series at the Massachusetts General but does bear out the observations of others. A more detailed analysis is as follows:

Simple postoperative adhesions	54
Acute appendiceal and peri-appendiceal involvement	8
Pelvic abscess	1
Volvulus	10
Incarcerated or strangulated hernia	12
Metastatic carcinoma	6
Primary carcinoma of the small bowel	1
Idiopathic perforation of the ileum	2
Carcinoma of the cecum	2
Fecalith in the ileum	1
Gallstones in the ileum	2
Thrombosis of superior mesenteric artery	1
TOTAL	100

Twenty per cent of the cases had obstruction of the gut on the basis of gangrene.

None of the patients in whom diagnosis was made within twenty-four hours succumbed. All who did die had histories of over seventy-two hours duration with the single exception of the patient with superior mesenteric thrombosis. An analysis of 15 deaths follows:

Peritonitis	2
Chemical imbalance	3
Carcinoma of small bowel	1
Volvulus	4
Carcinoma of cecum	1
Cardiac	1
Metastatic cancer	2
Superior mesenteric thrombosis	1
	15
OVER-ALL MORTALITY	15%

It is obvious from the above that gangrene of the bowel and resection increase the gravity of the situation. Veal (15), Johnston (11), and others (20, 21) have reported similiar reduction in mortality with the use of blood, fluids, antibiotics and sulfonamides.

POSTOPERATIVE MANAGEMENT

The postoperative management of these cases follows closely the preoperative management. In the cases with intubation prior to surgery the tubes were left in place so that decompression could be carried out if necessary. Fluids, blood, and sulfa and penicillin are used as adjuncts when necessary. It is interesting to note that in 7 cases dyspnea and edema developed postoperatively after the administration of too much fluid intravenously. All of these pa-

tients were over fifty years of age, reaching that time of life when water becomes a liquid only to bathe in. Yet they were receiving 3,000 c.c. of fluid by vein, or over, per day, in an erroneous attempt to maintain fluid balance. Restriction of fluid was the only treatment necessary to overcome their difficulty. We feel that the subcutaneous route is perhaps the best method of administering parenteral salts, although it is a little more distressing.

The average hospital stay was 18.5 days, including the period of preoperative intubation.

SUMMARY

(1) We have attempted to correlate the roentgenologic and clinical pictures of acute small intestinal obstruction and to outline a course of successful management. Until the surgeon can realize that the roentgenogram of the abdomen is his single best method of establishing the early diagnosis of bowel obstruction, his mortality in this entity will be high.

(2) We have described a pathognomonic sign on the roentgenogram of the abdomen which, when it exists with pertinent clinical findings, should lead to a preoperative diagnosis of gangrene of the bowel.

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SUMARIO

Obstrucción Aguda del Intestino Delgado

La obstrucción aguda del intestino delgado constituye un caso de urgencia quirúrgica y radiológica. La atención de la misma comprende cinco fases: (1) diagnóstico rápido y exacto; (2) descompresión; (3) restablecimiento del equilibrio fisiológico; (4) cirugía; (5) asistencia postoperatoria. Todas se discuten a base de 100 observaciones.

La localización, gravedad, forma y du-

ración de la oclusión pueden averiguarse con una radiografía simple del abdomen. El cuadro de la obstrucción mecánica nos presenta un asa o asas intestinales distendidas por gas. En cambio, en el íleo paralítico el gas aparece distribuido en muchas bolsas. Si hay gangrena, el intestino pierde rápidamente su contorno fisiológico para convertirse en un tubo liso distendido por gas. La presencia de una o varias asas intestinales en C que proceden del mismo sitio son indicaciones de vólvulo. La pérdida concomitante de las válvulas conniventes es proporcional a la perturbación del riego sanguíneo.

En toda clase de oclusión de las asas está indicada la cirugía inmediata. Si hay distensión y desequilibrio químico, debe ejecutarse la descompresión preliminar por medio de la sonda de Miller-Abbott. La administración, tanto pre como post-operatoria, de sangre íntegra y plasma se halla indicada para restablecer el equilibrio proteico y electrolítico, basándose la misma en la determinación de la cifra de cloruros y el tenor de nitrógeno no proteico y seroproteínas.

La operación se propone eliminar la causa de la oclusión. En la serie analizada, las causas más frecuentes fueron: adherencias postoperatorias simples (54 por ciento), hernia irreducible o estrangulada (12 por ciento) y vólvulo (10 por ciento).

La asistencia postoperatoria se conforma bastante a la preoperatoria, la descompresión según esté indicada y el mantenimiento del equilibrio líquido.

Al terminar, señálase que, hasta que el cirujano se dé cuenta de que la radiografía abdominal le ofrece la mejor manera de establecer el diagnóstico temprano de la oclusión intestinal, seguirá teniendo una mortalidad alta en dicho estado.

Extrinsic Deformities of the Colon[1]

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IN THIS ERA OF rapid technical advances in roentgenologic diagnosis, it is easy to forget what may be learned from ancient and simple methods of examination. It is easy, too, in this day of specialization within the specialty, to succumb to the temptation to divide the human anatomy into separate parts, forgetting the relation to other parts. Anatomical variations in the position of the colon, and displacement of the colon by enlarged livers, enlarged spleens, and massive pelvic tumors were demonstrated in the early days of roentgenology, but there is yet much to be learned about the pressure effects that normal and diseased viscera may exert on the barium-filled colon. The differentiation of these defects from those produced by intrinsic lesions of the colon is not always easy. No hard and fast rules can be drawn, but evaluation of filling defects must be based on a correlation of history, physical findings, roentgenologic findings, and a knowledge of anatomy and pathology. The dictum that the mucosa is not involved in extrinsic lesions is helpful, but one must be wary of his version of a normal mucosa of the colon. Often, all we can honestly do is to tell the surgeon that we do not know whether the colonic lesion is intrinsic or extrinsic, and that he must enter the abdomen prepared for a resection.

Thirty years ago, Carman and Miller (1) wrote: "Displacement of any part of the colon may be produced by extrinsic tumors of every sort, including those of the liver, kidney, pancreas, spleen, uterus, and adnexa; by adhesive bands, by pregnancy, and by psoas abscess. Displacement commonly affects only those portions of the colon which are more or less movable, the hepatic flexure being occa-

Fig. 1. Depression of hepatic flexure by carcinoma of right kidney.

sionally, and the splenic flexure, rarely, implicated. Fixation of the cecum may be the result of appendicitis, tuberculosis, pelvic conditions, or malignancy. Cases of so-called Jackson's membrane may deform the cecum and ascending colon."

Wiese and Larimore (2), in 1932, reviewed 126 cases of extra-alimentary tumors encountered in routine examination of the gastro-intestinal tract, and discussed in detail the deformities produced by those tumors. Fleischner (3), in the same year, discussed deformity of the colon by inflammatory and neoplastic processes in the immediate vicinity of the colon, and stated that these might cause edema of the intestinal wall by blockage of lymphatics and blood vessels. He quoted one case in which there was extensive deformity of the ascending colon due to metastasis to nodes
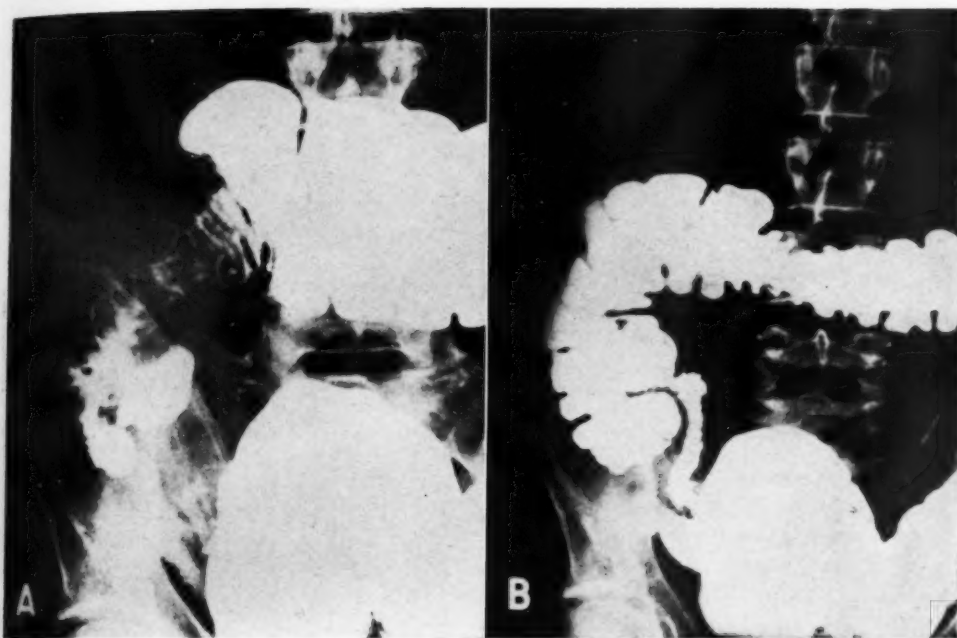
Fig. 2.   Deformity of ascending colon (A) by perinephritic abscess, with restoration of normal colonic contour (B) after drainage of abscess.   (Courtesy of Dr. Allan Tuggle, Charlotte, N. C.)
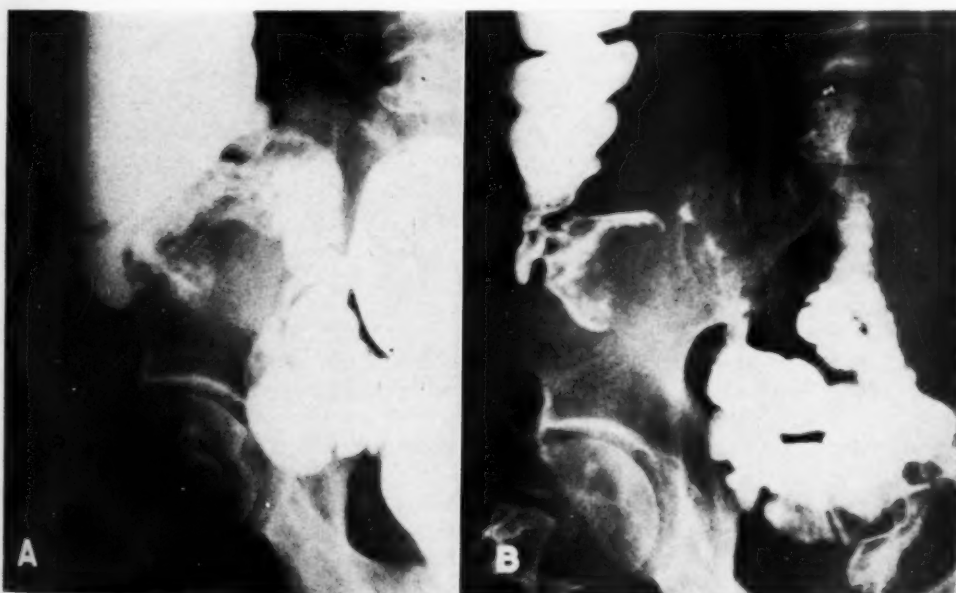

Fig. 3.   A.   Deformity of cecum by appendiceal abscess.   B.   Same case after evacuation of barium enema.

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Fig. 4.   Inverted cecum with appendiceal abscess producing pressure defect on ascending colon.

in the ileocecal angle from a sarcoma of the right kidney and ureter. Hubeny (4), in 1939, in a paper entitled "Extra-Alimentary Causes of Alimentary Filling Defects" showed several cases in which the colon was deformed or displaced by extrinsic masses. One of these was an ovarian cyst located lateral to the ascending colon and displacing it medially. In another, a cystic mass in the pancreas displaced the splenic flexure downward.

Hinkel (5), in 1942, reviewed the roentgenologic findings in mesenteric cysts and reported three cases. He gave three guides as to their location: (1) Anterior and freely movable masses are in the omentum. (2) Less movable masses indenting the gastro-intestinal tract from behind are in the mesentery. (3) Immobile masses lying far posteriorly are retroperitoneal. Ladd and Gross (6) reported omental cysts displacing the colon.

Jenkinson and Brown (7), in 1943, studied 117 cases with reference to constricting lesions of the rectum and sigmoid colon. Forty per cent of their series had endometrial implants on the rectosigmoid. The characteristic roentgenologic findings, according to these authors, are: (1) a filling defect approximately 4 to 7 inches long; (2) sharp demarcation of the filling

defects, similar to carcinoma; (3) little evidence of disorders in other parts of the colon; (4) an essentially intact mucous membrane; (5) fixation and tenderness to palpation during fluoroscopic examination. Combined with these findings were the following clinical observations: (1) occurrence of endometriosis, in general, in a younger age group than carcinoma; (2)

Fig. 5.   Non-rotation of colon with appendiceal abscess deforming cecum.

associated sterility and menstrual abnormalities; (3) absence of weight loss and anemia; (4) complete restoration of the bowel lumen on examination two months or more after surgical castration.

Very recently, Marshak (8) made an excellent and exhaustive study of extrinsic lesions affecting the rectosigmoid, in an attempt to establish some roentgenologic criteria for these lesions, independent of the history and pelvic examination. Space does not permit a detailed discussion of his paper, but it represents a zealous effort to distinguish between the deformities of extrinsic lesions and carcinoma of the bowel, and is well worth careful study.

Extrinsic deformities of the colon may be roughly grouped as follows:

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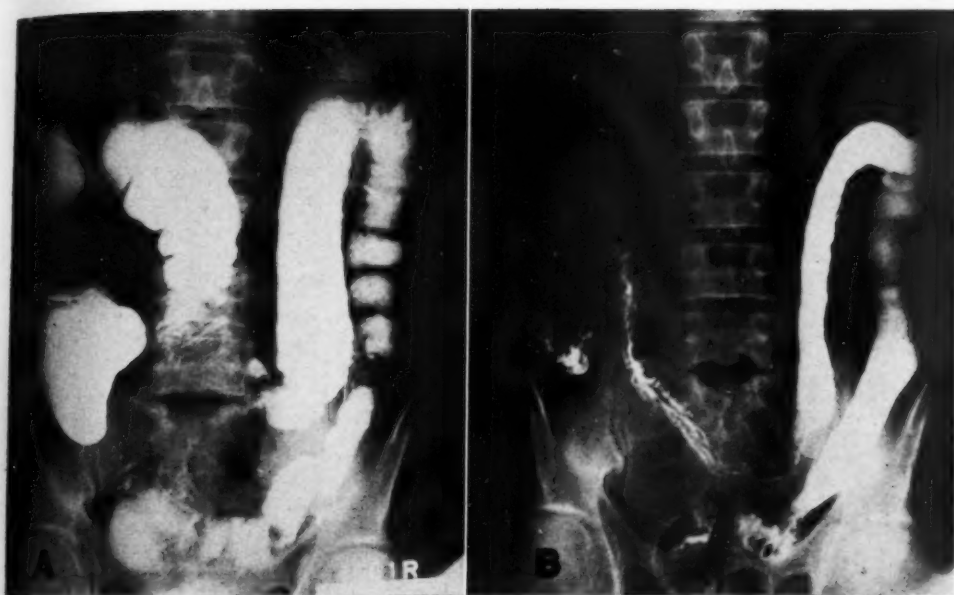
Fig. 6. A. Palpable mass in lower abdomen with deformity of transverse colon. B. Same case after evacuation of barium enema. Operation revealed leiomyosarcoma of colonic wall with abscess perforating into omentum.
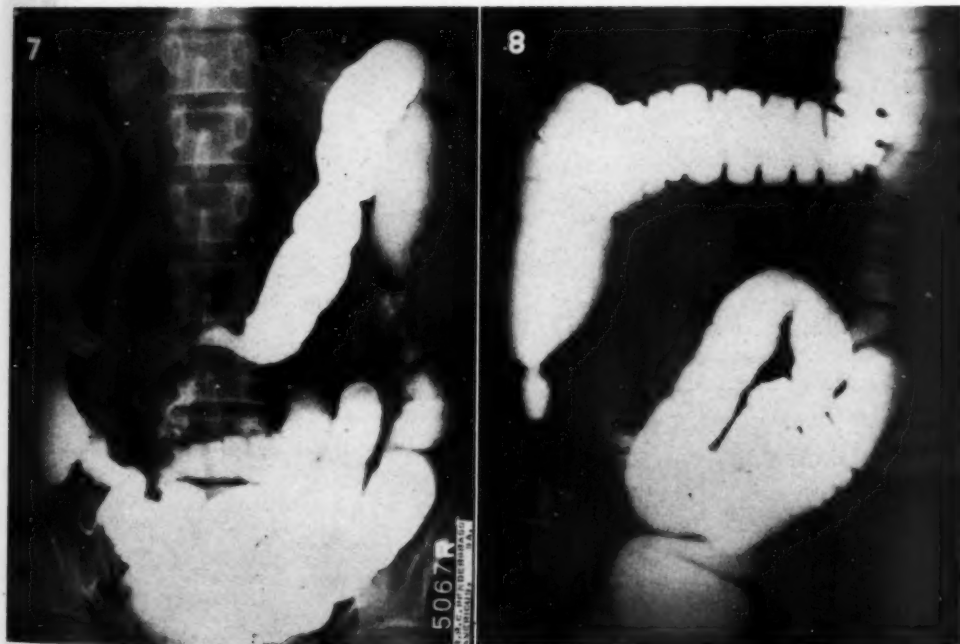
Fig. 7. Palpable mass in right abdomen with long history of diarrhea. Note deformity of transverse colon and barium escaping from fistula of ileum. Final diagnosis: Ulcerative colitis with abscess and ileal fistula.
Fig. 8. Deformity of cecum and terminal ileum. Proved ileocecal tuberculosis.
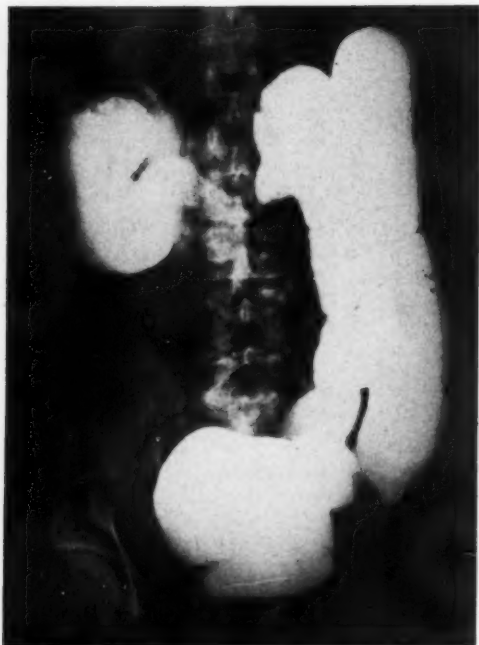
Fig. 9.   Case of generalized carcinomatosis secondary to carcinoma of stomach.   Upward displacement of cecum thought to be due to lymphatic masses but found at autopsy to be cecum lodged in hernial sac.

Fig. 10.   Descending colon caught in inguinal hernia sac.

(1) Deformities from enlarged viscera, including tumors of these viscera.

(2) Deformities from inflammatory processes, adhesions and endometriosis.

(3) Deformities from retroperitoneal tumors, mesenteric tumors, and omental tumors.

(4) Deformities from tumors of the colonic wall not invading the mucosa.

(5) Deformity from intra-abdominal and inguinal hernia.

METHOD OF EXAMINATION

The examination always includes a scout film of the abdomen, fluoroscopy during filling of the colon, with spot films as indicated, films of the filled colon in various positions, and fluoroscopy and films of the colon after evacuation of the barium enema.   The writer has found it very helpful, in some instances, to make a vaginal examination under fluoroscopic observation while the colon is filled with barium.

This procedure helps to separate masses in the right pelvis from the distended cecum.   On occasion, a mass felt in the right pelvis, thought to be an ovarian cyst, has been demonstrated to be a distended pelvic cecum.

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SUMARIO

Deformidades Extrínsecas del Colon

La diferenciación de los efectos debidos a la presión en el colon lleno de bario, de las deformidades producidas por lesiones colónicas intrínsecas, resulta difícil y tiene que basarse en la correlación de la historia, los hallazgos físicos, los hallazgos radiológicos y el conocimiento de la anatomía normal y la patológica.

Las deformidades extrínsecas comprenden: (1) deformidades debidas a vísceras hipertrofiadas, incluso tumores de las mismas; (2) deformidades debidas a procesos inflamatorios, adherencias y endometriosis; (3) deformidades debidas a tumores retroperitoneales, mesentéricos y epiploicos; (4) deformidades debidas a tumores de la pared colónica que no invaden la mucosa; (5) deformidades debidas a hernias intrabdominales e inguinales.

El examen comprende: una radiografía exploradora del abdomen; roentgenoscopia mientras se llena el colon, con radiografías instantáneas; radiografías del colon ya lleno, en distintas posiciones; y roentgenoscopia y radiografías del colon después de haberse evacuado el bario. El examen vaginal bajo inspección roentgenoscópica mientras el colon está lleno de bario puede resultar útil para separar las tumefacciones de la pelvis derecha, del ciego distendido.

Barium Sulfate in Saline Suspension

Examination of the Colon in the Presence of Partial Obstruction[1]

GEORGE M. WYATT, M.D.

Washington, D. C.

THERE IS A SMALL group of patients with symptoms of unexplained rectal bleeding or abdominal tumor who present an unusually difficult diagnostic problem to the roentgenologist. These patients fall into two categories:

Fig. 1B. Case I: Right anterior oblique view of the colon about one hour after Fig. 1A.

Fig. 1A. Case I: Postero-anterior film taken sixteen hours following oral administration of barium sulfate and magnesium citrate. There are numerous diverticula throughout the colon. The entire mid portion of the sigmoid colon is narrow, but there are no definite filling defects.

(1) The patient who cannot retain an enema because of a relaxed or damaged anal sphincter or perineum. Some of these patients will expel even a rectal tip surrounded by an inflated rubber balloon, and since the usual oral barium sulfate mixture becomes rapidly dehydrated in the colon, it is of little value in outlining anatomical lesions.

(2) Patients who do not have clinical obstruction or dilatation of the intestine but who present complete obstruction to the retrograde passage of a barium enema. It is with this group of patients that the present paper is primarily concerned. Many of these patients have diverticulitis, and a small percentage also have rectal bleeding due to the diverticulitis. The incidence of carcinoma in the age group in which such patients fall is, however, so high that every effort must be made to exclude a source of bleeding other than the diverticula.

The oral administration of barium sulfate has long been considered dangerous in the presence of any obstruction of the descending or sigmoid colon because of the probability of dehydration and impaction of barium-containing feces proximal to the obstruction. It is well known that barium sulfate administered orally is frequently
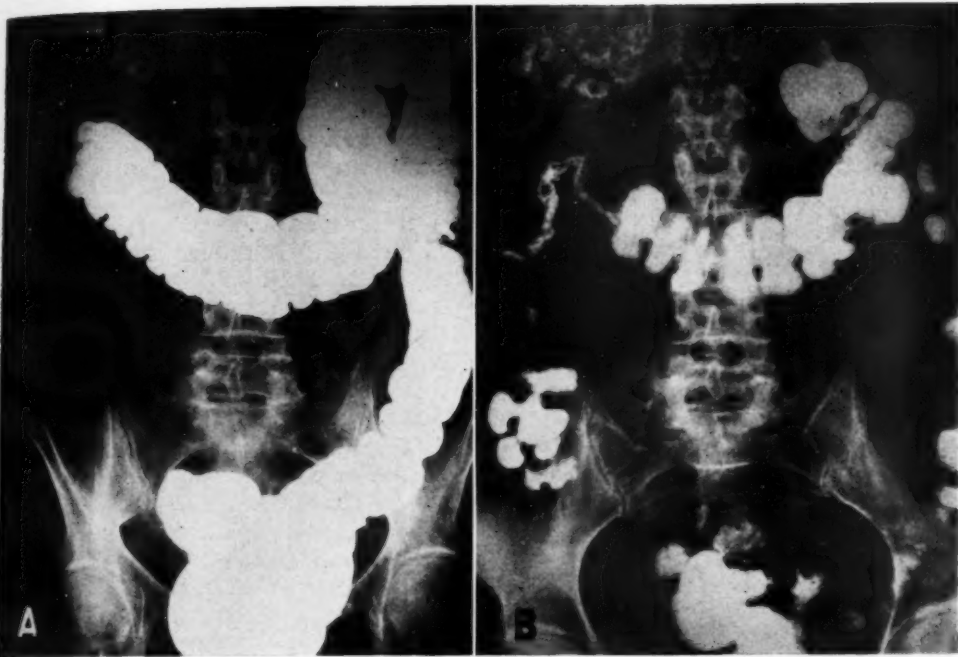
Fig. 2A and B.   Case II: A.   Barium enema showing the colon filled to the hepatic flexure.   No definite filling defect could be demonstrated and the patient could not tolerate injection of additional barium.

B.   Postero-anterior film of the colon ten hours following oral administration of barium sulfate and magnesium citrate.   A filling defect is demonstrated just proximal to the hepatic flexure.   See also Fig. 2C.

Note: At operation, the calcified mass in the right upper quadrant was palpated in the region of the right adrenal gland, but further exploration was not attempted.
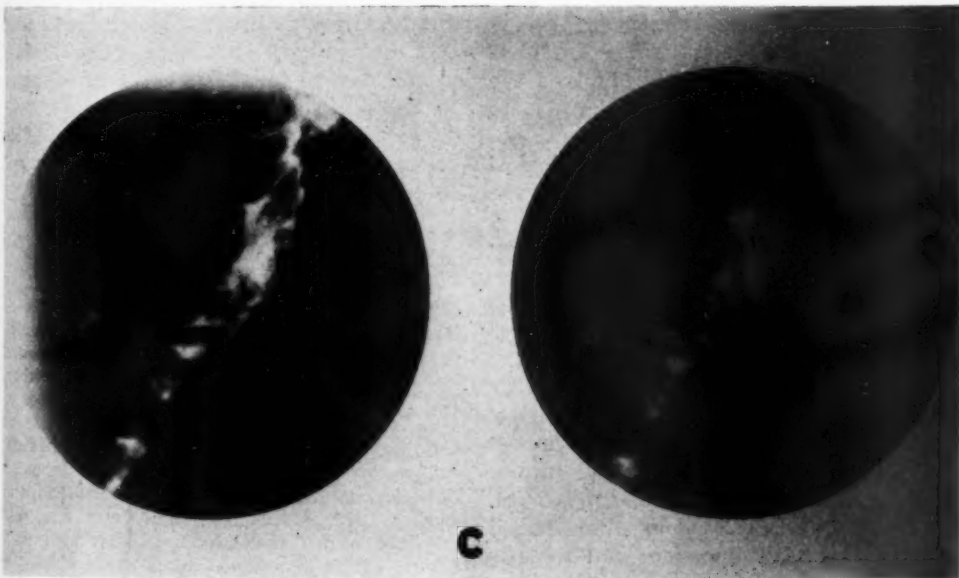
Fig. 2C.   Case II: Compression spot films of the filling defect shown in Fig. 2B.

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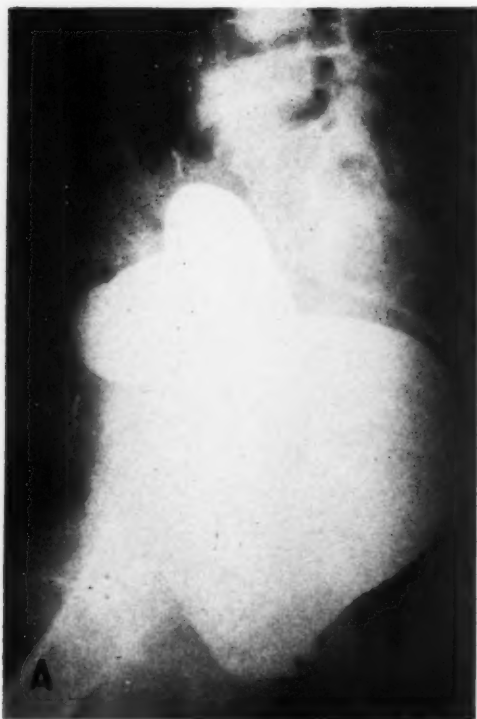
Fig. 3A. Case III. Lateral view of rectum and distal sigmoid colon following attempted barium enema. Any further distention of the rectum was considered dangerous and the enema was discontinued.

passed with difficulty even by normal patients. If, however, dehydration of the barium mixture can be prevented, it is no more likely to cause impaction and obstruction than normal feces. One logical method of preventing dehydration of the barium in the left colon is to administer it with a saline cathartic which, by its very nature, maintains and increases liquefaction of the contents of the colon. This method has been employed as follows:

(1) The patient, if not already in the hospital, is hospitalized.

(2) Four ounces of barium sulfate powder, *i.e.*, half a tumblerful, is mixed with 8 oz. of magnesium citrate (liquor magnesii citratis, U. S. Pharmacopeia, Vol. 13, p. 294). This mixture is administered orally early in the morning and the patient is allowed water *ad lib*. Another 8 oz. of magnesium citrate, without additional

barium, is given about an hour and a half later, and fluoroscopy is then done at intervals starting about two hours following the administration of the barium. The speed of passage of the barium-saline mixture varies markedly with the degree of obstruction and the age and physical activity of the patient. Excretion is usually almost complete at the end of eighteen hours or earlier. Such patients must obviously be kept under roentgenologic observation until the barium is excreted and should be kept in the hospital for facilitation of such observation.

Many clinicians are justifiably opposed to the administration of either barium enemas or cathartics to patients with diverticulitis. Eggers (1) states that it is important not to use force with the barium enema for fear of causing a perforation. He cites one case in which severe pain followed a barium enema with later development of an abscess which resulted fatally. Hayden (2) advises against the use of cathartics in the presence of diverticulitis but cites no instances in which their use resulted unfavorably.

When a patient with diverticulitis also presents rectal bleeding, the radiologist should confer with the referring physician and the evidence should be weighed and balanced as to which is the greater danger to the patient, danger of perforation or danger of allowing a carcinoma of the colon to extend beyond the stage where successful removal may be possible.

CASE REPORTS

CASE I: M. P., white female, age 79, complained of severe constipation and intermittent rectal bleeding. The constipation had increased in severity over a period of two months and was accompanied by occasional abdominal distention and vomiting. Relief was obtained only by catharsis. Proctoscopy and sigmoidoscopy revealed no source of bleeding. The patient was placed on sulfasuxidine.

Three attempts were made to examine the colon by barium enema, on Dec. 31, 1945, Jan. 5, 1946, and April 1, 1946. On April 2, 1946, the patient was admitted to the hospital, barium sulfate with magnesium citrate was administered orally, and the examination was conducted as outlined above. In this instance, it was sixteen hours before the barium
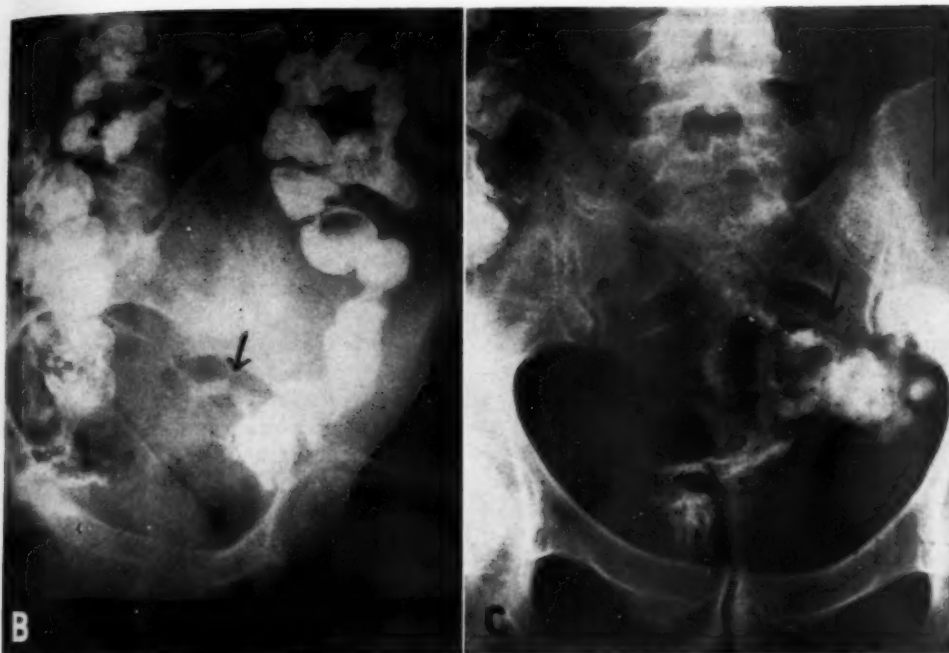
Fig. 3B and C.   Case III: B.   Oblique view of the sigmoid colon taken approximately eight hours following oral administration of barium sulfate and magnesium citrate.   The barium is just entering the proximal sigmoid colon and passing part way around a mass at the point indicated by the arrow.
C.   Postero-anterior film of the sigmoid colon, taken two hours later, shows more complete filling of the sigmoid colon and rectum with barium.   The filling defect indicated by the arrow corresponded to the adenocarcinoma which was later removed.

reached the rectum but it was excreted after twenty-four hours. Numerous diverticula were demonstrated, and an area of narrowing in the mid and distal portions of the sigmoid colon, but no definite evidence of carcinoma was seen (Fig. 1A and B). Complete visualization of the sigmoid colon could not be obtained, due to a combination of irritability and overlapping loops of large bowel. Operation was considered inadvisable because of the patient's advanced age and poor physical condition. A tumor was present, however, and was visualized by sigmoidoscopy on July 4, 1947, at which time obstruction had become complete. Biopsy led to a pathological diagnosis of adenocarcinoma. Colostomy was refused and death occurred on July 20, 1947.

CASE II: A. J., white female, age 72, was admitted to the hospital on Jan. 15, 1947, complaining of weakness and with a blood picture of secondary anemia (red cells, 3,000,000 per cu. mm.; hemoglobin, 56 gm. per cent). There was no gross rectal bleeding and the benzidine test for occult blood was negative. Two attempts were made to examine the colon by barium enema, Jan. 16 and Jan. 17. The colon could be filled only to the hepatic flexure, however, and no filling defect could be demonstrated

(Fig. 2A), although there was a small palpable mass in this location. The patient was given barium sulfate and magnesium citrate and fluoroscopy was done at intervals, as above. In this instance, best visualization of the ascending colon was obtained about ten hours following the administration of the barium, at which time a definite filling defect was demonstrated (Fig. 2B and C). The ascending colon and hepatic flexure were resected and the distal ileum anastomosed to the transverse colon. The gross specimen showed an almost completely annular ulcerated tumor, the pathological report on which was adenocarcinoma. There was no evidence of metastasis and the patient is still living, although there is clinical evidence of local recurrence.

Comment: The precaution of using magnesium citrate in this instance may have been superfluous, since the retrograde obstruction was in the right side of the colon and the patient was passing feces by rectum. The obstruction was, however, so complete that the use of magnesium citrate was considered advisable; in addition it gave the advantage of a more fluid mixture.

Case III: G. E. W., white female, age 50, was admitted to the hospital Dec. 30, 1946, with pain in the left lower quadrant of the abdomen starting two weeks previously with constipation. This had been partially relieved by cathartics but three or four days later nausea and vomiting occurred and blood clots were noticed in the stools. On Dec. 31, examination of the colon by barium enema was only partially satisfactory because of extreme irritability of the sigmoid. Diverticula were demonstrated and a diagnosis of diverticulitis was made. The patient was given penicillin and streptomycin with some improvement. On Jan. 4, 1947, another attempt to examine the colon by barium enema was completely unsuccessful because no barium could be forced beyond the distal sigmoid portion (Fig. 3A). There was recurrence of the left lower quadrant pain and rectal bleeding after about two weeks. On Jan. 21, examination of the colon following oral administration of barium and magnesium citrate revealed an indefinite filling defect measuring approximately 3 cm. in diameter in the mid sigmoid area, very strongly suggestive of tumor in this location in addition to the diverticulitis (Fig. 3B and C). On Jan. 28, a Mikulicz resection of the sigmoid colon was performed, with release of multiple adhesions in the pelvis. The pathological report was adenocarcinoma. The colostomy was closed on

April 8 and the patient continued well for about four months, when symptoms of recurrence developed. Death ensued on Oct. 11, 1947. Autopsy revealed extensive metastasis to the liver and lungs.

DISCUSSION

Examination of the colon by oral administration of barium in combination with a saline cathartic is rarely indicated. There is, however, a small group of patients presenting the picture of obstruction of the colon to the passage of a barium enema without clinical obstruction. In these patients, the use of a saline cathartic will prevent dehydration and impaction of the barium and allow examination of the colon with barium by mouth.

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SUMARIO

Sulfato de Bario en Suspensión Salina.   Examen del Colon en Presencia de Oclusión Parcial

El examen del colon mediante la administración oral de bario combinado con un catártico salino está rara vez indicado. No obstante, hay un grupillo de enfermos que, sin obstrucción clínica, presentan el cuadro de obstrucción colónica al paso de un enema de bario. En esos enfermos, el empleo de un catártico salino impedirá la deshidratación y el estancamiento del bario y permitirá el examen del colon con bario administrado por vía bucal.

Bien temprano por la mañana se administra una mezcla de sulfato de bario (120 gm.) y citrato de magnesio (240 gm.), seguida como a la hora y media de otros 240 gm. de sulfato de magnesio solo. A partir de unas dos horas después de la administración de la mezcla de bario se hacen roentgenoscopias de cuando en cuando. Hay que mantener al sujeto en observación roentgenológica hasta que termine la excreción de bario (por lo general al cabo de 18 horas o menos), debiendo hospitalizársele para dicho fin.

Comuníquense tres casos en que se utilizó dicho procedimiento.

DISCUSSION

(Papers by Wells; Lockwood, Smith, and Walker; Pendergrass; Wyatt)

Harvey Morrison, M.D. (Boston, Mass.): Intellectual curiosity has always been an important attribute of a good radiologist. His willingness to follow each patient through all the steps of modern medical procedure—history, physical examination, laboratory work, treatment, surgical procedures, to final anatomical diagnosis—in addition to the careful practice of his own specialty, is emphasized in this morning's program.

The remarks of Dr. Wells and the complementary scientific exhibit of Dr. Fleischner[1] should give us a little more confidence in drawing distinctions between the normal and abnormal ileum. To me, this is one of the more difficult regions to examine, either with barium from above or by barium enema. An interesting supplement to Dr. Wells' paper, as she suggested, would be to establish a definite age range at which the terminal ileum changes from the pre-adult to the adult configuration. It is also possible that further study may reveal that the "cobblestone pattern," when it assumes a different size or shape or changes in any way, may indicate a disease process which gives symptoms in the right lower quadrant such as Dr. Golden has discussed and Dr. Wells mentioned.

Dr. Lockwood has shown our responsibility in the early diagnosis of the "acute abdomen." It is somewhat difficult at times to make an early diagnosis. It is not as easy for me as it seems to be for Dr. Lockwood. Frequently I have been forced to take repeated films over short intervals, and the variation in gas patterns or lack of it has been a valuable diagnostic aid. One of the cases that Dr. Lockwood presented illustrates the changes which may occur. I confess the first film was diagnostic, but with the second film one's convictions are strengthened. Occasionally the bowel fills with fluid in the early stages and apparently doesn't show the typical obstructive picture. Later a little gas will indicate where the lesion is and what it may represent.

We have all had the experience of seeing a series of flat films showing no gas of any characteristic pattern, though clinically and surgically there was definite obstruction. I don't know how to get around this rare problem unless definite fluid-filled loops are distinguished.

Extrinsic lesions of the colon have always interested me. I wish there were a way to draw a diagram and with each compression or deflection of the colon be able to state what organ is represented and to what the pressure defect is due. Dr. Pendergrass has the same difficulty. He can demonstrate the lesion and point the finger of

suspicion, but sometimes he must await the report of the surgeon or pathologist to learn what organ has been indicted.

I would hesitate to endorse any widespread use of pelvic examinations under fluoroscopic control. I feel very strongly that the radiologist's hands are very important organs and that no unnecessary risk should be taken. I think there are other safe methods which will give the same results.

I am much interested in Dr. Wyatt's paper. He has simply added to our troubles, however. He has left us still between the horns of a dilemma and has added a third horn. The surgeons and internists don't want barium by mouth, they don't want an enema, and they don't want catharsis, but they do want a diagnosis.

A very enlightening fact that we could establish would be the number of patients whose bowels have been ruptured by an enema given from a low enema can and through a rubber catheter. I think sometimes (and this is confirmed in several cases which I have been able to check) that the Foley type catheter, with too great pressure and too great haste, has been partially responsible. One case I checked was of particular interest. The perforation was blamed on the barium enema, but fortunately the barium enema had been given six months prior to the perforation! Many of our impressions in this matter would stand a more critical analysis of the facts.

It is extremely important to make the diagnosis in this type of lesion and, when the sphincter is weak, Dr. Wyatt's procedure seems to add to our armamentarium.

Question: I would like to ask Dr. Wyatt: Is it difficult to get rid of the barium?

Question: I would like to ask Dr. Lockwood to discuss his experience with pitressin in differentiating between a complete and a partial obstruction.

Question: I would like to ask how large the small bowel must be before Dr. Lockwood considers it distended. Also, is the finding of gas in the small bowel, associated with fluid levels, invariably pathological? That is, is it invariably true that fluid levels in the small bowel mean obstruction?

Question: I would like to ask Dr. Lockwood how to distinguish between gas in the small intestine from obstruction and that due to kidney stone.

Dr. Leo Rigler (Minneapolis): I should like to go beyond the privileges of a Chairman to ask Dr. Wells two questions: One is whether these lymphoid deposits are confined, so far as she

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[1] Roentgen Anatomical Studies of the Ileocecal Valve and Observations on Its Pathology.

knows, to the terminal ileum, or their appearance at least; secondly, whether she has encountered any cases of sarcoidosis of the small intestine such as we reported, in which a similar cobblestone appearance was produced, also by lymphoid deposits, but very abnormal ones.

Dr. Wells (*closing*): As to your questions, Dr. Rigler, I don't know how extensive these deposits may be. The pathologists tell me that the lymphoid tissue is greater in the terminal ileum than higher up, but we have not taken spot films of the small intestine higher up routinely. Nor have we made any special studies of sarcoidosis in the small intestine. It would seem logical that mesenteric lymphadenitis would be associated with lymphoid infiltrations in the terminal ileum of perhaps greater than normal size. I think this remains to be determined. The distinction between what is abnormal and what is normal in a child may be rather delicate.

Dr. Lockwood (*closing*): The gas found in the small bowel as the result of acute mechanical small intestinal obstruction is distinguished from the gas that is often found in the patient with kidney stones, or in those where manipulation of the genito-urinary tract has taken place, by the fact that, in the latter, small areas of isolated loops of small intestine may be moderately distended and the valvulae conniventes are present, while in mechanical small intestinal obstructions, and especially where gangrene of the bowel is taking place, the valvulae conniventes have been obscured and we usually have but a single loop of distended small bowel. The size of the bowel in acute mechanical small intestinal obstruction is of little or no significance.

The use of pitressin is contraindicated in any case where we have characteristic evidence of a gangrenous bowel on the roentgenogram. The differentiation of acute mechanical small intestinal obstruction from ileus may be a difficult problem; however, in mechanical obstruction we have an active bowel until very late in the disease. The loops of the small intestine have a tendency to assume the typical stair-step position with the valvulae conniventes showing. In the case of gangrene of the small bowel, a single loop may loose the valvulae conniventes, while in ileus the gas-filled intestine, both large and small, may be dilated; there is a loss of valvulae conniventes, and the gas may be scattered throughout the whole intestinal tract.

In answer to the question whether the fluid level in the small bowel is of any significance, in my opinion it is not.

Dr. Wyatt (*closing*): One question was how to get rid of barium proximal to the obstruction. That is one reason for having the patient in the hospital when the examination is attempted. The barium must be followed through until it is evacuated. The patient should receive large quantities of fluid and additional magnesium citrate may be given to keep the contents of the colon liquid. Our experience has been that, if feces have been coming through, this mixture will come through.

I would like to reinforce Dr. Lockwood regarding the dilemma between the surgeon wanting a diagnosis and not wanting the examination. The surgeon is as interested in the patient as we are, and if the two of us cannot come to an agreement that this examination is more important than some possible danger to the patient, the examination should not be done.

Roentgen Treatment of External Infections
Due to Bacillus Anthracis[1]

DR. MANUEL RIEBELING

Guadalajara, Mexico

SINCE MAY 22, 1944, we have treated 36 patients with infections produced by *Bacillus anthracis*.[2] The local lesions were diagnosed clinically as "malignant pustule"; where regional manifestations were also present, the diagnosis was "malignant edema." Malignant pustule may be mistaken clinically for a simple furuncle or carbuncle. The diagnosis in our cases was proved by the demonstration of *Bacillus anthracis* in smears. In 27 cases a single lesion was present; in 8 there were two lesions, and in 1 case there were four. Twenty-two of the patients were males, 14 females. Twenty-five were over fifteen years of age. The remainder were children from one to fifteen.

In 16 cases (44.4 per cent) the disease appeared to be local or regional; systemic manifestations were present in 16 cases, and in 4 (11.2 per cent) the patients were in a state of coma when first seen. Complications occurred in 20 cases (55.6 per cent).

The anatomical distribution of the lesions was as follows: head and neck, 20 cases (55.5 per cent); hands, 3 cases (8.3 per cent); forearms, 4 cases (11.2 per cent). Multiple lesions, as mentioned above, were present in 9 cases (25 per cent).

Seven patients had been previously treated, without improvement: 3 by cauterization; 1 by intravenous injection of bovine serum; 3 by penicillin.

X-ray therapy appears to be of little significance for the mild localized infections, in many of which recovery occurs without treatment. In cases with severe local or regional manifestations, with general reactions or coma, it is our impression that the situation is quite different. In such cases radiological treatment has produced rapid and sometimes dramatic improvement in both the local and general condition, and *Bacillus anthracis* has disappeared from the exudate, usually in one to three days after irradiation was begun. If these observations could be confirmed in a larger series of cases, roentgen therapy might be established with advantage as both a preventive and therapeutic measure in this disease.

Except for two mild cases in which treatment was refused, all of our patients remained under observation long enough to justify our claim of an immediate good response to irradiation; all were known to be symptom-free within periods of fifteen days to two months. Notwithstanding these excellent results, roentgen therapy is not without risk, especially in complicated cases, and should be undertaken only by a well trained radiologist.

TECHNIC OF TREATMENT

In a few benign and localized lesions, a single treatment was given. In the majority, the principle of fractionation was employed. Mild cases were treated every twenty-four to forty-eight hours, the dose per field varying from 18 to 85 r. Improvement was usually observed in a few days, and thereafter treatment was given only twice a week. In patients who were very ill, treatment was begun with a small dose to each field, usually 18 r, every twelve hours. The interval between treatments was increased after one or two days to twenty-four hours, and later to seventy-two hours. Because of surface irregularities and the extent of involvement, some cases were treated through multiple fields,

[1] Presented at the Thirty-third Annual Meeting of the Radiological Society of North America, Boston, Mass., Nov. 30–Dec. 5, 1947.
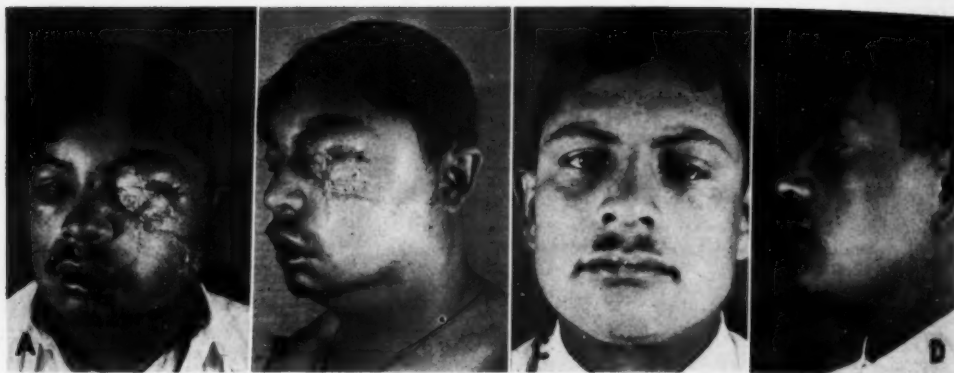[2] *Bactéridie charbonneuse*, Davaine, 1850.

Fig. 1. Case I. A and B. Before roentgen treatment. C and D. Following treatment.

sometimes six to eight. The treatment was highly individualized, as will be seen from the accompanying case histories, which give details as to dosage, number of fields, etc.

Treatment was given with radiation of medium penetration—140 kv., with filtration of 2.0 mm. of aluminum to 0.25 mm. copper and aluminum. The usual skin distance was 30 cm.

Although in a number of cases the eyes, eyelashes, eyebrows, and scalp were included in the field of irradiation, no depilation occurred. In some cases with gangrene of the skin, the resultant scar did not produce a functional defect even in the eyelids.

Some of the more impressive clinical histories follow:

CASE I (treated in May 1944): J. R. M., 29 years old, a farmer, four days before consultation noticed a small dark spot in the skin of the left lower eyelid. In twenty-four hours it was surrounded by small vesicles. At the end of forty-eight hours local edema appeared, and within seventy-two hours this had involved the left side of the face and neck.

On the fourth day, when the patient was first seen, the edema extended from the forehead to the lower part of the neck, and involved the mucosa of the lips and the left cheek (Fig. 1, A and B). The entire left side of the face was deformed and painful, and nodes were palpable in the neck. The skin of the lower and part of the upper left lid appeared necrotic; the exudate was found to contain *Bacillus anthracis* in considerable numbers. The condition of the patient indicated a generalized reaction. The blood pressure was low, the temperature slightly elevated, and the pulse rapid. The clinical diagnosis was malignant

edema. The patient had previously received two intravenous injections (50 c.c. each) of serum without benefit.

X-ray treatment was instituted with fractions of 54 r, measured on the skin, to each side of the face. Seven treatments were applied on the left side and four on the right side. Seven treatments were also given to the left side of the neck. For the first four days treatments were given every twenty-four hours, three fields being treated daily. Later the interval was increased to forty-eight hours or longer to reduce the cumulative effect of the radiation. After some rest, four additional treatments were given to the left orbital region. Care was taken to avoid epilation.

Improvement was noticed in the first twenty-four hours. Bacteriological smears were made every forty-eight hours, and at the second investigation the organisms had disappeared. Treatment was continued for eighteen days. At the end of that time no edema was present and necrotic tissues were eliminated. Dressings of 2 per cent boric acid solution were applied for some time, and in forty-five days a good scar was present (Fig. 1, C and D). The patient has reported for periodic examination and appears normal three years after treatment.

CASE II (treated in May 1945): J. N., a 27-year-old housewife, had for years had non-pigmented areas on the skin due to vitiligo. Nine days before consultation she received a blow on the left cheek. The following day a small sore black spot appeared. On the second day this was surrounded by vesicles and on the third day edema was present, soon extending to the rest of the face and the neck. The patient was in pain and for the last two days the temperature was elevated.

Examination showed the face and neck to be deformed by edema, most prominent on the left side. There was a necrotic lesion 3 cm. in diameter on the left side of the chin (Fig. 2, A and B). The patient experienced great pain trying to open the mouth; the mucosa of the left cheek was swollen and a

necrotic area 2 cm. in diameter was present. Smears of the exudate showed numerous anthrax bacilli. The diagnosis was malignant edema complicated by incipient gangrene of the cheek and general symptoms.

X-ray treatment was at first given every other day to the right, left, and anterior surfaces of the face and the neck—80 r × 3 on the skin. Later the treatments were more widely spaced, with intervals of two and three days, and the fields were reduced. Each field received 480 r in fifteen days.

Fig. 2. Case II. A and B. Before roentgen treatment. C and D. Following treatment. The white patches due to vitiligo were unaffected by the irradiation.

The general reaction disappeared at the end of twenty-four hours, and the local symptoms improved in forty-eight hours. At the end of the treatment only a small sore persisted, which healed in forty-five days (Fig. 2, C and D). The patient was under observation for a year, and the local and general condition remained excellent. The non-pigmented areas in the skin were not modified.

CASE III (treated in June 1945): M. A. T., a 36-year-old housewife, noticed a small black spot on the skin of the left upper eyelid six days before consultation. In twenty-four hours vesicles appeared around the spot and it increased in size. The face and neck became edematous and when examined the patient was unable to open the eye (Fig. 3, A and B). The skin of the lids was tense and the borders were covered with vesicles producing a serous exudate,

Fig. 3. Case III. A and B. Before roentgen treatment. C and D. Following treatment.

smears of which showed numerous anthrax bacilli. Some systemic reaction was present. The diagnosis was malignant edema with general reaction. No previous treatment had been received.

Roentgen therapy was instituted at once with a dose of 66 r to anterior and lateral fields on the face, repeated in forty-eight hours. Four treatments, totaling 264 r, were given to each field in twelve days. At the end of that time the edema had disappeared; there was desquamation over an area 2 cm. in diameter on the upper lid, followed by healing, with restoration of normal function in a few weeks (Fig. 3, C and D). Forty-eight hours after the first treatment the exudate was free from *B. anthracis.*

CASE IV (treated in September 1945): J. E. R., a 12-year-old boy, first noticed a small black spot on the right side of the chin. Forty-eight hours later a local sore was present and the face and neck were edematous. By the time of examination, four days after the first symptom, the edema had become so severe that the face and neck were deformed, especially on the right side, and the eye was closed (Fig. 4 A and B). A necrotic ulcer, 2 cm. in diam-
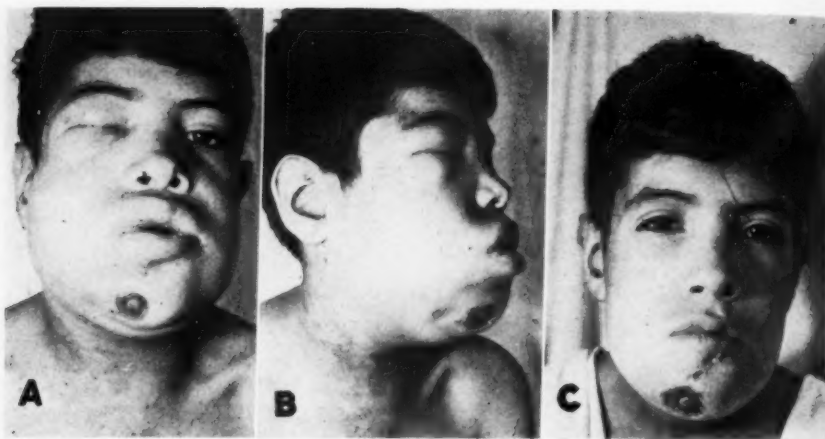
Fig. 4. Case IV. A and B. Before roentgen treatment. C. Following treatment.

Fig. 5. Case V. A and B. Before roentgen treatment. C. Following treatment.

eter, was present on the right side of the chin and the patient was unable to open his mouth because of the pain. Anthrax bacilli were demonstrable in smears of the exudate. The general condition was poor. The diagnosis was malignant edema. No previous treatment had been received.

Roentgen therapy was begun at once to four fields, right, anterior, and left facial and right cervical. Each field received 18 r on Sept. 29 and on Sept. 30 and again on Oct. 1, 3, 5, 9, and 13. The general symptoms disappeared in the first forty-eight hours, local improvement was marked, and the exudate no longer showed the presence of *B. anthracis*. Only a small local lesion remained at the completion of treatment (Fig. 4, C).

CASE V (treated in October 1945): F. P., a 33-year-old housewife, noticed a small sore on her left cheek one week before consultation. This increased in size and edema developed until, on examination, the left side of the face was so swollen that the eye

could not be opened (Fig. 5, A and B). On the left cheek was an area 3 cm. in diameter covered by a dark crust and surrounded by a ring of vesicles 6 cm. in diameter. The exudate contained large numbers of *B. anthracis*. The diagnosis was malignant edema.

The patient had received in the preceding thirty-six hours half a million units of penicillin without benefit. This was discontinued and x-ray therapy was given—18 r daily to each of three fields, anterior and left facial, and left cervical, for four days, making a total of 72 r to each field. The number of organisms in the exudate had diminished twenty-four hours after the first treatment. The local symptoms were promptly relieved, and the patient was discharged in good condition in twelve days (Fig. 5, C).

CASE VI (treated in May 1946): J. M., a man of 37, had discovered a small pustule on the upper part of the left cheek six days previously. The face became edematous after forty-eight hours, and symp-

toms of a general reaction developed. On the second day a vesicle appeared on the dorsal surface of the right hand, and this also was accompanied by edema.

Examination showed edema of the face and neck, most severe in the left orbital region (Fig. 6, A and B), and of the dorsal surface of the hand. There was an ulcer, 2 cm. in diameter, on the left cheek, and another, measuring 1 cm., on the right hand. Exudate from these showed *B. anthracis* in abundance. Evidence of a systemic reaction was present. The diagnosis was malignant edema, with double localization and general reaction.

X-ray therapy was given to two fields on the face, one on the neck, and one on the hand. Each of the fields on the face and neck received four treatments —25 r each—in five days. The hand received a single treatment of 160 r.

There was an increase in the severity of the general symptoms in the first twenty-four hours but by the end of forty-eight hours the condition was almost normal, the organisms had disappeared from the exudate, and the edema was much reduced. The patient was discharged on the tenth day with the skin lesions almost healed (Fig. 6, C and D).

CASE VII (treated in May 1946): R. N., a man of 40 years, noticed a small pimple on the upper left eyelid forty-eight hours prior to examination. Some hours later there was edema of the orbital region, soon extending to involve the left side of the face. This was accompanied by fever.

On examination, the patient was found to have symptoms of general reaction and intoxication. His appearance was comatose. Because of the edema of the left side of the neck, examination of the site of the primary lesion was impossible. *B. anthracis* was found in large numbers in the local exudate. The diagnosis was malignant edema with very severe general reaction.

Roentgen therapy was given to four fields—two on the face, anterior and left lateral, and two on the neck, also anterior and left lateral. Each field was given 20 r every twenty-four hours for five days. A week later a final treatment was given, bringing the total dose to each field to 120 r in eleven days.

During the first few hours of treatment the general reaction appeared to increase, but by the end of twenty-four hours there was definite improvement and after the second day general symptoms had disappeared, the local manifestations had become less severe, and anthrax bacilli were no longer present in the exudate. At this point an unexpected complication developed. The patient became irrational and had to be isolated. Neurological and medical consultation led to a diagnosis of acute avitaminosis due to deficiency of nicotinic acid. Appropriate therapy was instituted and within forty-eight hours the neurologic symptoms disappeared. Meantime the edema had subsided. A necrotic area on the cutaneous surface of the left lids remained, but eventually healed after several weeks.

CASE VIII (treated in May-June 1946): J. S., a

Fig. 6. Case VI. A and B. Before roentgen treatment. C and D. Following treatment.

12-year-old country boy, was seen with symptoms of four days duration. A small pustule had appeared on the skin of the chin, with painful edema developing shortly thereafter, so that the patient could open his mouth only with difficulty. Symptoms of a general reaction were present on examination; there was a necrotic area 4 cm. in diameter at the site of the primary lesion, and the neck and lower part of the face were edematous. *B. anthracis* was found in smears of the exudate, and a diagnosis of malignant edema was made.

Irradiation was directed to three fields on the face and neck, each field receiving four doses of 40 r each, on May 31, June 1, 3, and 4.

Marked improvement in the general and local condition was evident after twenty-four hours, and the exudate was nearly free from *B. anthracis*. At the time of the final treatment, general symptoms were no longer present. A local area of necrosis healed gradually.

CASE IX (treated in August 1946): M. M., a 28-year-old farmer, noticed a small black spot on the right lower eyelid four days before consultation. On examination, the right side of the face was found to be swollen, the eye was closed, but the general condition of the patient was good. On the lower right

Fig. 7.   Case X.   A and B.   Before roentgen treatment.   C and D.   Following treatment.

lid was a dark area 3 mm. in diameter from beneath which exudate escaped.   Smears revealed *B. anthracis*.   The diagnosis was malignant edema.

Three x-ray treatments were given in five days through anterior and lateral facial fields, the total dose being 186 r × 2.   The immediate response was excellent, and the patient was discharged with instructions to apply wet dressings for the next ten days.

CASE X (treated in August 1946): M. J. G., a 13-year-old girl, noticed a small pimple on the skin of the lower lip eight days before consultation.   Later the adjacent areas became edematous.   Penicillin was given without benefit and when the patient was examined by us the temperature was elevated, the pulse was rapid, and the blood pressure low.   The skin and mucous surface of the lower lip and part of the inner surface of the left cheek were involved by a suppurating ulcerative lesion, covered by necrotic tissue.   *B. anthracis* was demonstrated.   The lips and left side of the neck were edematous and cervical lymph nodes were palpable (Fig. 7, A and B).

X-ray therapy was directed to three large areas, anterior and right and left lateral, four exposures being given from Aug. 29 to Sept. 1.   Each field received a total dose of 104 r.   The general reaction disappeared in twenty-four hours and local improvement was also observed.   One week after admission the patient was discharged (Fig. 7, C and D) with instructions to continue the use of wet dressings.

CASE XI (treated in August 1946): E. M. C., an 11-year-old boy, discovered a black spot on the skin of the left cheek seven days before consultation. Within a few days edema of the face and neck developed, but the general condition remained good. Examination showed an area 3 cm. in diameter on the left side of the face covered by a brown eschar, with exudate containing *B. anthracis*.   The left side of the face and neck were deformed by edema and a
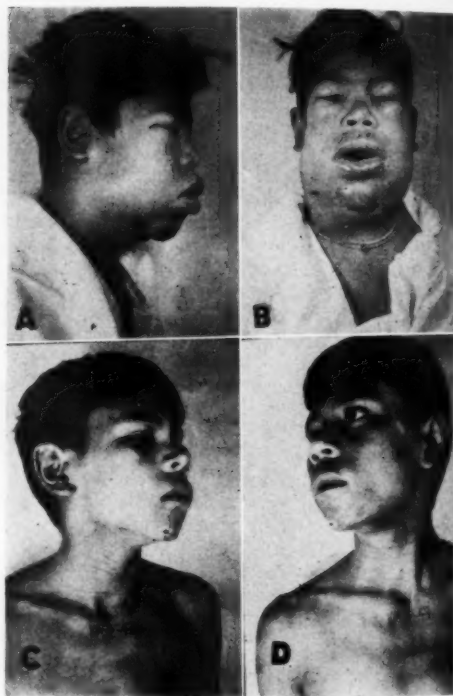
Fig. 8.   Case XII.   A and B.   Before roentgen treatment.   C and D.   Following treatment.

lymph node 3 cm. in diameter was palpable in the left cervical region.   The diagnosis was malignant edema.

X-ray therapy was given at once to three fields—anterior and left lateral facial and left cervical, 31 r to each.   So great was the improvement following the initial exposure that further irradiation was postponed for three days.   By that time the organisms had disappeared from the exudate and it was decided not to continue the treatment.   The patient was discharged with instructions to apply wet dressings for the next ten days.

CASE XII (treated in April 1947): M. B. A., a 12-year-old boy, gave a history of a sore on the chin appearing three days earlier, with subsequent edema of the face and neck (Fig. 8, A and B).   He had symptoms of a general reaction and marked depression.   A crusted necrotic area 3 cm. in diameter was

present, exudate from which contained *B. anthracis* in large numbers. The diagnosis was malignant edema.

Roentgen therapy was given to three fields—anterior and right and left lateral. Each field received a total of 480 r in eight doses over a two weeks period, the size of the fields being reduced as treatment progressed. Improvement was evident promptly after treatment was begun but the edema,

Fig. 9.   Case XIII.   A.   Before roentgen treatment.
B.   Two weeks after institution of treatment.

which was extensive, subsided more slowly than in the other cases. The result, at the end of two weeks, is shown in Figure 8, C and D.

CASE XIII (treated in April 1947): C.P.S., a 9-year-old boy, noticed a small black spot on the right lower eyelid three days before consultation. The face became edematous and on examination was so swollen, especially on the right side, that it was impossible to see the primary lesion (Fig. 9, A). A serous discharge from the lids showed *B. anthracis* in large numbers. The general condition of the patient was poor. He was comatose, with low blood pressure, rapid pulse, and fever. His inability to cooperate and the consequent feeding problem added to the difficulty of management.

X-ray therapy was given on April 5, 8, 10, 12, 15, 18, and 22, to three fields—anterior and right and left lateral. Later three additional treatments were given to the anterior field. The dose per treatment was 38 r. The fields were progressively reduced in size as the treatment proceeded. A gradual but definite improvement in the general condition occurred in the first forty-eight hours. Local improvement followed slowly (Fig. 9, B) and the patient was discharged at the end of a month.

CASE XIV (treated in June 1947): B.G., a 17-year-old youth, discovered a small pimple in the left temporal region five days before consultation. It increased in size and edema developed, especially prominent on the left side of the face. Fever and other evidences of a general reaction were present. The edema of the face involved the ear and temporal region. In the center was an eschar measuring 3×1

Fig. 10.   Case XV.   A.   Before roentgen treatment.
B.   Following treatment.

cm. surrounded by vesicles, fluid from which contained *B. anthracis*. The diagnosis was malignant edema.

X-ray therapy was given daily for three days, beginning on June 18, and again, after an interval of three days, daily for four days. One anterior and one lateral field were treated each day—the dose being 26 r.

At the end of thirty-six hours, the general condition had become normal and the organisms had disappeared from the exudate. The local manifestations gradually subsided and the patient was sent home on June 30. At the last observation, July 7, there had been no depilation.

CASE XV (treated in July 1947): B. G., a 30-year-old farmer, had a small pustule on the neck with subsequent development of edema involving the neck and lower part of the face. Examination, eight days after appearance of the pustule, showed a mild general reaction, extensive edema of the face and neck (Fig. 10, A), and vesicles surrounding the original lesion. Fluid from these contained *B. anthracis*. The diagnosis was malignant edema.

Roentgen treatments were given on July 12, 14, 15, 17, 19, 22, 24, and 26, the rays being directed obliquely to two anterolateral fields, each receiving 33 r. There was relief of the general symptoms at the end of twenty-four hours and the exudate no longer showed the presence of *B. anthracis*. The local manifestations were gradually modified (Fig. 10, B), and the patient was discharged July 29.

SUMMARY

Infections with *B. anthracis* are of common occurrence in that part of Mexico from which this report comes. Many cases are resistant to ordinary medical treatment, and the morbidity and mortality are significant.

A series of 36 cases, all bacteriologically

verified, have been treated by roentgen irradiation since 1944. In 20 or 55.6 per cent of these there was a general reaction from which some mortality was to be expected. Small doses of moderately penetrating rays (140 kv., 2.0 mm. aluminum to 2.5 mm. aluminum and copper filtration) were given daily, or at intervals of a few days, usually to several fields. In all the cases there was prompt response to irradiation. *B. anthracis* disappeared from the exudate from the primary lesion and general and local manifestations subsided. No complications incident to treatment were observed.

Fifteen case histories are summarized.

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DISCUSSION

James F. Kelly, M.D. (Omaha, Neb.): We are indebted to Dr. Riebeling for an excellent presentation. He showed some seriously ill patients, and his results have been very much like ours in the treatment of gas gangrene: the onset is rapid, the toxemia is severe, the destruction of tissue is extensive, and the mortality is high. In practically every respect I think his report parallels our reports on the x-ray treatment of gas infection. Anthrax is apparently another type of infection that responds to x-ray better than to other measures.

In experimental work at Duke University, as I shall later point out in my own paper, Glenn has shown that 140 kv. is the optimum kilovoltage, that forty-eight hours after x-ray is started it has reached its optimum effect, and that this effect wears off in about a week. He also found 100 r per day to be the optimum dosage. His work corresponds to that done previously by other workers, and clinically it is supported very well by our series of patients treated for gas infection. But it must be kept in mind that what can be done in a gas infection is accomplished, even though less dramatically, in other acute toxic infections. The more chronic type of infections must be treated over a period of time and will respond to a small dose once a week.

SUMARIO

Roentgenoterapia de las Infecciones Externas Debidas al Bacillus Anthracis

Las infecciones por el *B. anthracis* son frecuentes en la parte de México de donde procede esta comunicación. Muchos casos se muestran resistentes al tratamiento médico corriente, y la morbidad y mortalidad revisten importancia.

Desde 1944, se ha tratado con los rayos X una serie de 36 casos, todos comprobados bacteriológicamente. En 20, o sea 55.6 por ciento, había una reacción general que hacía temer alguna mortalidad. Se administraron pequeñas dosis de rayos de penetración moderada (140 kv., filtración por 2.0 mm. de aluminio a 2.5 mm. de aluminio y cobre), a diario o a plazos de varios días, por lo general a varios campos. En todos los casos hubo una respuesta rápida a la irradiación. El *B. anthracis* desapareció del exudado de la lesión primaria y cedieron las manifestaciones locales y generales. No hubo mortalidad. Tampoco se observaron complicaciones relacionadas con el tratamiento.

Sumarízanse 15 historias clínicas.

Roentgen Rays in Prevention and Treatment of Infections[1]

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Omaha, Nebr.

THE CLINICAL use of x-rays in infections was begun immediately after Roentgen's discovery. Its history is one of alternate periods of hope and despair. The inconsistency in the early results is easily explained by the variations in output not only of different installations and different apparatus but also, from day to day, of the same apparatus. The lack of a suitable means of measurement and the instability of the early gas tubes easily account for the great variation in the clinical results. When one did not know what dose he was administering at any given time, how could he repeat it at intervals or develop any real clinical judgment?

It has been different during what we may call the second period of roentgen therapy, in which we have had, for all practical purposes, a satisfactory physical unit of dosage, the roentgen. One can now measure the dose when a treatment is given, and can repeat it or vary it as he sees fit. Under these circumstances, it has been possible to learn the effects of various amounts of radiation and to consistently duplicate the doses used in one's own work or that of others—both clinical and experimental. This has permitted agreement on many important points.

EVOLUTION OF DOSAGE RATIONALE

The earliest positive results in radiation therapy were observed clinically in treating cancer with the large doses which are required to kill malignant cells. On the basis of this experience, large doses were also used in the treatment of infections but without much success. We now realize that in dealing with infections the object is not to kill the bacteria but to support the defense mechanism of living tissue, which requires relatively small doses. The importance of small doses was first recognized from clinical experience. These small doses, when used for infections, may be correctly termed stimulating doses. If large doses are used, a depressing effect is obtained. Thus the matter of dosage is important.

The conclusion that time and the presence of living tissue are also essential factors in order to obtain any beneficial effect is abundantly supported by a review of the literature during the entire fifty years of the use of x-rays for infections. In such a review several facts are evident.

(1) The dosage factors in the roentgen therapy of infections are entirely different from those in the treatment of neoplasms. These differences must be understood and utilized if good results are to be obtained.

(2) When properly used, x-rays will prevent or cure certain acute toxic infections. The course of some infectious processes is shortened and often limbs and lives are saved.

(3) The effect of x-rays is non-specific.

(4) There are no real hazards connected with this type of treatment when properly given with present-day equipment which has been accurately calibrated.

(5) There are no dangerous side reactions or sequelae, nor are hypersensitive or allergic states created which prevent future roentgen treatment.

(6) Since treatments may be given with a mobile apparatus at the bedside, it is not necessary to move the seriously sick or injured patient.

(7) There is a definite economic factor involved in early and complete recovery which reacts favorably both upon the patient and upon medicine as a whole, in

that the cost of medical care of many serious infections is greatly lessened.

(8) Certain chronic infections may be benefited greatly by x-ray therapy properly applied.

(9) To obtain beneficial effects in treating infections there are three essentials: adequate dosage of x-ray, living tissues, and a suitable time factor.

slowing of the respiratory rate, decrease in toxemia, decrease of pain, conservation of tissue, prevention of secondary infections, and shortening the course of the disease. Above all there is a decrease in mortality.

In subacute or chronic infections the results are not so spectacular. In this group
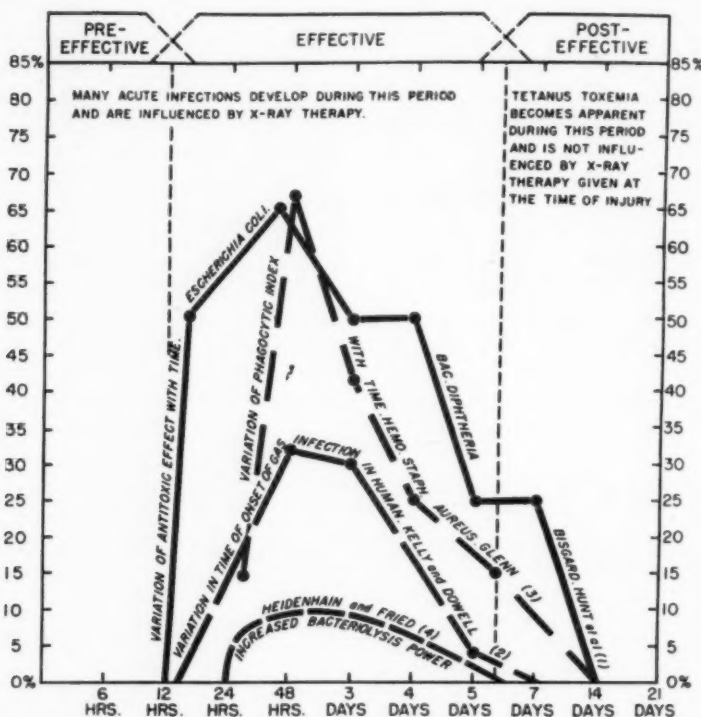
Chart I. A study of the time-efficacy relationship of acute infection and x-ray response (experimental) supporting the use of x-rays in prophylaxis and therapy. From this composite graph (Bisgard; Kelly and Dowell; Glenn; Heidenhain and Fried), it is obvious that if prophylactic irradiation is instituted soon after an injury occurs, the period of protection begins in a few hours and continues for several days beyond the time that a gas infection is likely to develop. Since the antitoxic factor is non-specific in character, it is also evident that the danger of infection from many other organisms is also eliminated or greatly minimized by irradiation.

CLINICAL EFFECTS OF X-RAYS

In acute toxic infections, the latent period between x-ray treatment and reaction is but a few hours. The following favorable clinical responses are usually noted: slowing of the pulse, localization of the infection, lowering of temperature,

the response is slower and it usually takes some time to determine whether or not benefit is to follow. But, while the beneficial effect of x-rays is more difficult to prove in chronic types of infection, nevertheless much good follows their use. The present paper will be limited to acute infections.

A rather complete discussion of the experimental and clinical data bearing on

POST-TRAUMATIC   DIABETIC

Chart II. Importance of early x-ray treatment. Ineffectiveness of serum. It is evident that serum has no influence on the course of t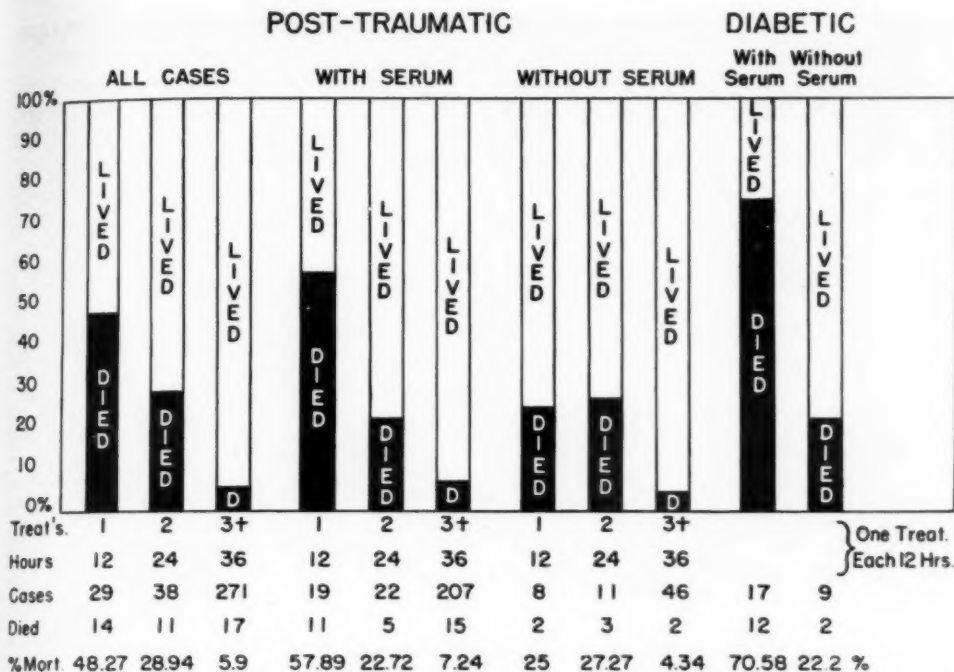he disease and that the recovery rate is definitely dependent upon the promptness with which x-ray treatment is begun. The highest mortality is in the group receiving serum and only one x-ray treatment, and the lowest (4.34 per cent) in the group of 46 patients who had no serum, and no amputations, but were treated by x-ray early and lived long enough to reach the effective period of irradiation. It is demonstrated that amputation is no longer necessary.

this problem was contained in our last paper which was read by title at the annual meeting of the Radiological Society in November 1945, and was published subsequently in RADIOLOGY. Since that time, our attention has been called to the recent work of Glenn, which gives additional support to the conclusions concerning the importance of the correct dosage and the time factor if good results are to be obtained. He demonstrated that a highly significant increase in the phagocytic index of a healthy rabbit against *Staphylococcus aureus* can be produced forty-eight to ninety-six hours following irradiation with a dose of 100 r (air) delivered at 140 kv. He also showed that a dose of 100 r was the most effective, that the effect was not apparent until some hours had elapsed after the administration of the x-rays, and that the effect was limited to a five- to

seven-day period after the first dose was given; furthermore, that after a short period of rest the same increase in the phagocytic index could be produced in the same animal if more radiation was given.

Glenn's observations are in accord with those of previous experimental workers and with the clinical observations of many who have claimed beneficial effects in the treatment of acute infections (Chart I). In order to correlate briefly these experimental observations with the clinical aspects of the problem, we are again going to refer to the data available in the literature concerning the treatment of gas infection.

The analysis of the mortality in x-ray-treated gas infections several years ago revealed the importance of treating as early as possible. These data showed that among patients living only long enough to receive one treatment (twelve hours), the

Fig. 1.   Case II: Film taken the day after admission to hospital, showing several comminuted fragments of the right humerus in its middle and upper thirds.   Two wires are holding the fragments together, and there is gas in the soft tissue of the arm, above the clavicle, and down along the chest wall in the axilla.

mortality remained the same as if no x-ray had been used, or about 50 per cent; among those living long enough to receive two treatments (twenty-four hours), the mortality was reduced to 29 per cent, and among those surviving long enough for three or more treatments (thirty-six hours) the mortality dropped to 6 per cent (Chart II).   In other words, a pre-effective stage of irradiation is present clinically as well as experimentally.   A prophylactic dose administered during this period, the first twelve hours, will be of tremendous value, and the non-specific action of the x-rays will prevent many types of wound infection.

Another feature of the x-ray effect brought out by Glenn, which is in accord with clinical observations, was the response of the animals to a second dose of x-rays after the effect of the first dose had been dissipated.   We also noted this in the treatment of patients in whom a reactivation of the gas infection supervened when some repair surgery was attempted at a later date.   In these patients the effect of

the first x-ray treatment was lost but they would promptly respond to another dose.

Roentgen irradiation has not been shown to afford any protection against tetanus. This obviously is due to two factors, the limited period of activity of the x-rays, up to seven days, and the slow incubation period of tetanus infection, which is not apparent clinically until the second or third week or even later.   Since the x-ray has proved to be effective when given a second time where there is a reactivation of a gas infection, it seems likely that it would be well worth while to treat the toxemia of tetanus at the time its manifestations first appear.   Other measures, of course, must still be used for the treatment of tetanus when that unfortunate complication arises; the most important remains the use of antitetanus serum at the time of injury to prevent the disease.

During the summer of 1947, we did have an opportunity to treat a seven-year-old girl in whom tetanus developed five weeks after an injury to the foot.   Briefly the history of that case is as follows.

Fig. 2.　Case II: Film taken Sept. 11, 1946, one month after admission to the hospital, showing absence of three or four large comminuted fragments, amounting to a loss of one-third of the length of the bone.

Fig. 3.　Case II: Film taken Oct. 30, 1947, showing good union of the main upper and lower fragments.　The loss of bone structure has resulted in considerable shortening of the humerus.　The downward dislocation of the head of the humerus is also shown.　This dislocation is due to the loss of the supporting soft structures, about the shoulder joint, removed surgically during the first few days of the infection.

CASE REPORT: TETANUS

CASE I:　A girl, seven years of age, came into the hospital with a diagnosis of tetanus.　She was having considerable pain and some convulsions.　She was treated with large doses of antitetanus serum, phenobarbital, penicillin, streptomycin, avertin, orange juice, and glucose.　No sulfonamides were given.

X-ray treatment was started on the third day, as there was apparently no response to the other measures.　The patient was free of evidences of toxemia at the end of the first week, four days after irradiation was started, and went home, fully recovered, at the end of the second week.

This is the only case of tetanus we have treated and, because of the many measures used, we are not certain as to what role the x-rays played.　However, the patient got well and we would be willing to do our part over again.　We recommend x-ray therapy for tetanus in conjunction with other reasonable measures.

In the next case to be presented, however, we are certain about the role played by x-rays as a therapeutic agent, as we and others have had essentially the same experience in many cases over a period of practically twenty years, or since August 1928

CASE REPORT: GAS GANGRENE

CASE II:　A. H., a fifteen-year-old school girl, had her right humerus shattered in an auto-train collision on the morning of Aug. 11, 1946.　There was also considerable damage to the soft parts about the fracture site.

She reached the hospital in about one hour, was given anti-gas gangrene and antitetanus sera as well as penicillin.　The wound was cleaned up with present-day surgical technic for the prevention of infection, and the fragments of the humerus were

Fig. 4. Case II: Anterior view, Aug. 24, 1946, showing clinical improvement in a two weeks period. The large granulating surface will require plastic surgery.

Fig. 5. Case II: Anterior view, Oct. 30, 1947. The tissue which was removed surgically during the acute course of the disease has not yet been replaced. Plastic surgery was planned for the near future.

fixed in apposition by two wire bands about two inches apart. Despite the administration of penicillin and anti-gas gangrene serum and the use of surgical cleansing, a severe gas infection was evident in twenty-four hours.

The patient failed to show any improvement and on the evening of the third day, Aug. 14, consultants demanded that x-ray therapy be used.

We saw the girl about noon on the fourth day. She presented the familiar pitiful appearance of an advanced gas infection. The loss of the arm seemed inevitable, and the comatose condition of the child made the outcome, even as to life itself, doubtful. As soon as the attending surgeon finished removing all of the infected and suspicious tissues which were accessible for removal from the anterior part of the arm and the axillary area, we gave the patient an x-ray treatment.

The following day, Aug. 16, additional tissues were removed from the anterior chest wall. Due to severe reaction following the use of some serum during the night, we ordered that no more serum be used. Penicillin was continued. Two x-ray treatments were given on this day and two more on

the next day, Aug. 17. Additional tissue was also removed from the anterior chest wall. Very little tissue was removed at any time from the posterior chest wall as the patient was too seriously sick to permit the manipulation required for this procedure. Some deep incisions were made, however, which permitted escape of gas and drainage of fluid. This tissue subsequently recovered, while the tissue which had been removed anteriorly from the arm and the chest was, of course, a total loss.

What this difference in surgical procedure means to the patient is apparent in the photographs and x-ray films (Figs. 1–7). The extensive removal of tissue has permitted dislocation of the head of the humerus downwards, and considerable grafting will be required over the upper anterior arm and chest in order to improve the present condition and probably retain the head of the humerus in its joint cavity.

The last tissue was removed from this patient on Aug. 17. She was partially conscious the following day and quite clear mentally on Aug. 19. During the following week the wire sutures and the loose fragments of the humerus sloughed out. Later the
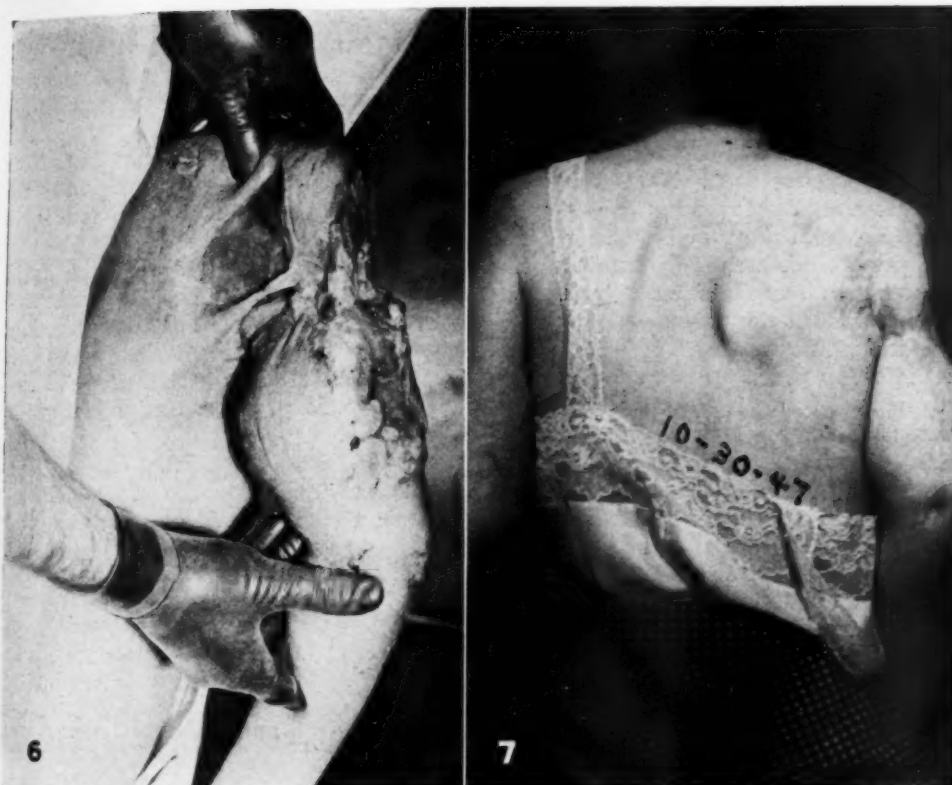
Fig. 6.   Case II: Posterior view, Aug. 24, 1946, showing clinical improvement in a two weeks period after injury (taken at same time as Fig. 4).   Note the long incision over the scapula to permit drainage of serum and escape of gas.   Since the patient was comatose during the acute phase of the disease, this area was not accessible for the daily removal of infected tissue, as was done anteriorly.   Much of the soft parts posteriorly therefore recovered fully.

Fig. 7.   Case II: Posterior view, Oct. 30, 1947, showing complete recovery of the tissues over the scapula. These tissues were as seriously infected as were the tissues over the anterior chest and in the deltoid region but, as they were not accessible for surgical removal because of the comatose condition of the patient, they escaped. Since 1935 we have pleaded that no tissue be removed because of infection until after the acute toxic phase of the disease has passed.

two main fragments above and below were drawn together and plated.   Later this plate sloughed out and the fragments then united with a quite firm bony union, as shown in Figure 3.

In reviewing this case, it is evident that continued use of penicillin and serum and repeated surgical removal of damaged tissue failed to prevent or control the gas infection.   Much of the infected tissue (posteriorly) was never removed and now is fully recovered.   It was not until x-ray therapy had time to take effect, however, that improvement was noted.

As early as 1935 and in every report since that time, we have pleaded for the minimum removal of tissue during the acute toxic phase of gas infection.   Those who have questioned our advice in this matter are requested to refer to our former reports and to study carefully the photographs here reproduced (Figs. 4–7).   The tissues posteriorly were as badly infected as were the tissues anteriorly but were saved because they were not accessible, in the patient's comatose condition, for a daily amputation.   We have insisted for many years that tissues which may seem hopelessly diseased during the acute toxic phase often recover; if they reach a true gangrenous stage, they will become de-

marcated as the toxemia regresses, and may then be removed with a minimum loss of tissue and with no added danger.

We are not convinced that penicillin is of any value for the prevention of gas gangrene and we know that serum is unnecessary if x-rays are used. Both serum and penicillin were employed in this case without effect, from the very beginning. The case proves, furthermore, that it is not necessary to amputate an extremity in order to control the toxemia of gas infection, though we were dealing with a virulent infection which progressed rapidly, as shown in Figure 1, taken twenty-four hours after admission to the hospital.

The effect of x-rays in preventing infection and conserving tissues presents a real challenge to the medical and surgical leadership of this nation. The procedure has been abused and ignored too long without any factual data to support such a stand. In the meantime, many arms and legs and lives have been lost. Our experience in the recent war should teach us for all time that directives of so-called authorities and resolutions passed by committees have no effect on physiologic processes or pathologic end-results. The long continued use of the sulfa drugs for the prevention of infection in our wounded service men, after they were known to be of no value, is a serious blot on the history of American medicine. It is to be regretted that we failed to correct or even protest such a mutilating procedure.

SUMMARY

In a brief review, some data, experimental and clinical, are presented in support of x-ray irradiation for the prevention and treatment of certain infections.

A case of tetanus and a case of gas infection are discussed. Each of these patients received penicillin, without apparent effect, before x-rays were used. In the case of tetanus so many methods of treatment were employed that it is impossible to attribute the result to any one of these. The patient with gas infection illustrates very well that amputation of an extremity is not

necessary for the successful treatment of gas gangrene if x-ray therapy is promptly instituted. It also proves that the removal of tissues during the acute toxic phase of the disease is unnecessary.

Obviously, due to the latent period of the effect of x-rays—from eighteen to twenty-four hours—treatment must be started early.

We are not convinced that the antibiotics will take the place of x-rays in the prevention or treatment of acute infection but they may be used simultaneously without ill effects. No sulfonamides, however, may be given in conjunction with irradiation.

Finally, we believe that no patient should be allowed to die of a bacterial toxemia without benefit of x-ray therapy.

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DISCUSSION

I. L. Loverud, M.D. (Manchester, N. H.): Dr. Kelly stated that x-rays and sulfonamides should not be used at the same time,. I wonder if he will offer some explanation for this.

Alvin C. Wyman, M.D. (Alexandria, Va.): I would like to ask Dr. Kelly about abscess of the lung. We had a case which I wanted to treat, but they would not let me.

Dr. Kelly (*closing*): I cannot answer the question about sulfonamides from an experimental standpoint, since our work has been mainly clinical. From January to May 1938, we had such unfavorable results that I knew that something was wrong. On looking at the records, we found that either prontosil or sulfanilamide had been used in practically every case in which we had an unusually poor result. We were losing cases that we did not need to lose. It was tragic. Basing our opinion on our observations in these cases, we stated in our report before the Radiological Society in 1938 that the sulfonamides and x-ray therapy should not be used simultaneously.

In my last report in the November 1946 issue of RADIOLOGY (page 478) are to be found all the references to the experimental work regarding the incompatibility of the sulfonamides and x-rays that I know anything about. Several men have done some good work in this experimental field. I believe there is also a report on the incompatibility of the sulfonamides and ultraviolet therapy, though I do not recall who made it. In our own experience we considered the clinical results too conclusive to await any experimental evidence.

Regarding abscess of the lung, I would say that we have been interested in treating the acute toxic type of infection, and that is where the x-ray effect is most dramatic. When it comes to treating an area which may contain pus, I think the situation is entirely different. A very small area might undergo resolution and absorption, but in the presence of pus in almost any location, especially when it has been there for any length of time and a thick-walled abscess is present, I think the indications are for surgery.

SUMARIO

Empleo de los Rayos X en la Prevención y el Tratamiento de las Infecciones

En una breve reseña, preséntanse algunos datos, experimentales y clínicos, en apoyo del empleo de los rayos X para la prevención y el tratamiento de ciertas infecciones.

Discútense un caso de tétano y otro de infección aerógena. Ambos enfermos recibieron penicilina sin mayor efecto antes de aplicarse los rayos X. En el caso de tétano empleáronse tantos métodos terapéuticos que es imposible imputar el efecto a ninguno de ellos. El caso de infección aerógena demuestra muy bien que no se necesita la amputación de un miembro para tratar con éxito la gangrena gaseosa si se inicia prontamente la roentgenoterapia. Demuestra además que es innecesaria la extirpación de tejidos durante la fase tóxica aguda de la dolencia. Claro está que debido al período de latencia del efecto de los rayos X—de 18 a 24 horas—hay que iniciar el tratamiento sin tardanza.

Los AA. no se sienten convencidos de que los antibióticos suplantarán a los rayos X en la prevención o tratamiento de las infecciones agudas, pero pueden administrarse simultáneamente sin efecto contraproducente. Sin embargo, no pueden emplearse los sulfonamidos conjuntamente con la irradiación.

Por fin, los AA. opinan que no debe dejarse morir a ningún enfermo de toxemia bacteriana sin recibir el beneficio de los rayos X.

Retrosternal Infiltration in Malignant Lymphoma[1]

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IT IS generally agreed that there are no uniformly pathognomonic roentgenologic signs of intrathoracic lymphomas, and that many different types of change may be encountered (9). Previously, investigators (5, 9) have classified the changes generally encountered into six groups: (1) mediastinal tumor; (2) hilar lymphonodular masses; (3) diffuse infiltration of lung parenchyma; (4) isolated nodules in the parenchyma; (5) pleural infiltration; (6) pleural effusion.

In our cases of the intrathoracic lymphoma group, we have occasionally observed a retrosternal infiltration, occurring alone or in conjunction with one or several of the usually noted localizations of lymphoma, but not previously described as such. It has been found with and without associated sternal involvement and presternal edema, and in all types of cases classified under the broad heading of malignant lymphoma.

PATHOLOGY

Lymphoid tissue involvement is the common denominator of the lymphoma group and, as Wolpaw *et al.* (10) have stated, "...the character of the disease in any organ or region of the body will therefore be determined by the location of its lymphoid tissue and the degree to which it is affected by the etiologic factor."

The retrosternal lymphoid tissue distribution is primarily represented by the bilateral, symmetrically arranged internal mammary chain of nodes, receiving afferent tributaries from the anterior parietal pleura and subpleural network on the pulmonary side, from the pericardium, and from the medial part of the chest wall *via* the intercostal lymph vessels. The bronchomediastinal trunks may also terminate
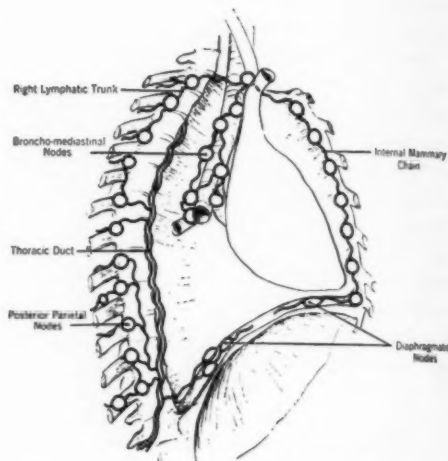

Fig. 1. Principal lymph nodes and lymph vessels of the thorax. (From "Lymph Node Metastases," by G. W. Taylor and I. T. Nathanson, Oxford University Press.)

by uniting with the internal mammary chains (Fig. 1) (8). It thus becomes evident that retrosternal involvement may be readily correlated with the anatomical distribution of lymphoid tissue within this region of the chest, arising as a frequent and often early extension from previously affected intrathoracic structures or by invasion from metastatic bone marrow foci in sternum and ribs, and possibly, also, as a primary focus.

Dresser and Spencer (4) and others (2, 3, 10) have noted that the sternum and ribs are favorite sites for bone involvement by lymphoma. From the facts presented above, it would seem likely that retrosternal infiltration might be encountered as a preliminary stage before actual bone infiltration, or as part of the soft-tissue reaction secondary to a preceding bone lesion.

Several cases have been reported in

which massive pulmonary involvement caused tough adhesions of granulomatous tissue to bind portions of the lung solidly against the chest wall, and in some of these cases the process extended transpleurally into the contiguous ribs (9).

Bone involvement in malignant lymphoma has been known for a long time, with the sternum, ribs, vertebral spine, and pelvis being most frequently affected. In one series showing bone changes, the lesions appeared early in the course of the disease in nearly 25 per cent of the cases (4). The high frequency of the involvement of the bones of the thorax in comparison with bones elsewhere in the body is a fair indication that this osseous invasion occurs mainly by contiguous growth. Dresser and Spencer (4) state that a primary Hodgkin's disease of bone without lesions in the lymph nodes, spleen, or liver has not been observed. Since the concept of bone involvement occurring mainly as a complication of a more or less generalized lymphadenomatous process with invasion from adjacent involved lymphoid tissue is a generally accepted one, it should not be surprising occasionally to encounter involvement of the retrosternal space before gross infiltration into the sternum has taken place. Dell, in a recent report (2), presented a case in which the lateral view of the chest showed a soft-tissue mass of fairly uniform thickness behind the sternum, which at autopsy was found to represent a massive infiltration of the periosteum of the sternum and ribs by chloroma in monocytic leukemia.

The close relationship of the lymph vessels of the chest wall, the extensive anastomoses between the subpleural and deeper intermuscular lymph vessels, and the subcutaneous lymph drainage explain how involvement and consequent blockage of the subpleural trunks may easily entail lymph stasis throughout the chest wall with secondary subcutaneous lymphedema. The presternal edema frequently encountered in our cases showing retrosternal infiltration may be explained by this mechanism, even without sternal involve-

ment in the earlier stages. However, in the majority of these cases we observed gross sternal invasion within a period of a few months after the appearance of the presternal swelling. In fact, the appearance of presternal swelling should lead to a search for retrosternal or sternal involvement. Once the sternum is involved, the tumefaction in the presternal region may represent actual tumor, secondary lymphedema, or both. The process in the sternum is usually destructive, but there may be bone proliferation and expansion, and occasionally pain will occur on deep inspiration (4) or be present continuously (3).

Pfahler (7) has called attention to the fact that involvement of the sternum in malignant disease is frequently overlooked, and others (2) have reported that, in cases of Hodgkin's granuloma, bones have been found to be involved roentgenologically without any symptoms referable to the osseous changes. Thus, the presence of retrosternal infiltration, accompanied by or without presternal edema, may reveal present or imminent sternal disease. Furthermore, since the roentgenogram showing sternal involvement in lymphoma is not characteristic (4) of the disease as such, the presence of concurrent retrosternal involvement may serve as an aid in the diagnosis.

ROENTGEN DIAGNOSIS

When the roentgenologist examines a patient referred with the clinical impression of malignant lymphoma, the first evidence sought for is enlargement of the hilar or mediastinal lymph nodes; and conversely, when well defined, lobulated masses are incidentally encountered along the trachea, at the tracheobronchial angle or bifurcation angle, or in the hilar regions, malignant lymphoma often heads the differential diagnostic list. (This is not true in children.) Enlargement of the hilar and mediastinal nodes is considered to be the most common manifestation of intrathoracic lymphoma (5) and when present will facilitate the diagnosis in a given
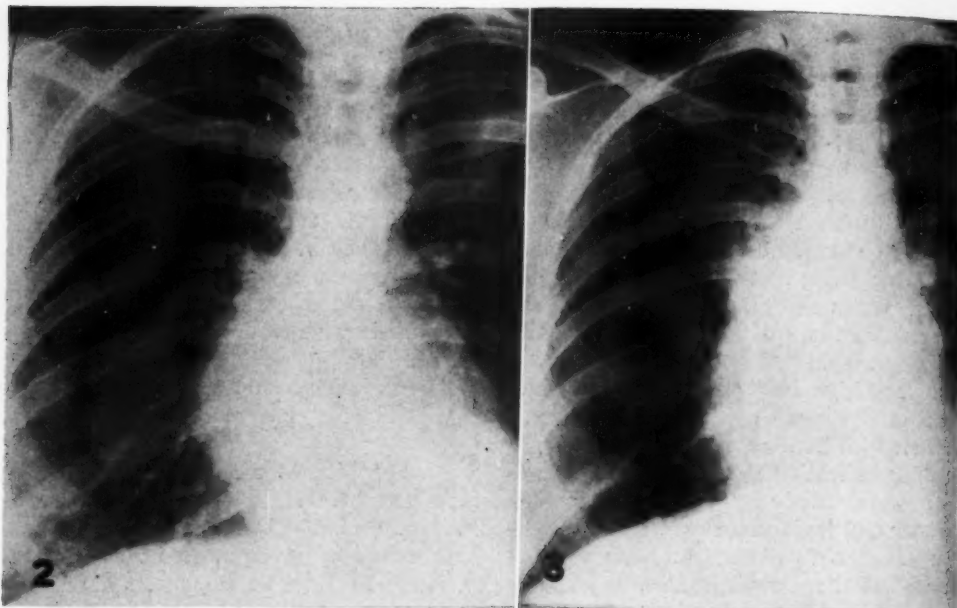
Fig. 2.   Case 1:   Hodgkin's disease.   First examination (April 30, 1942), showing widening of the lower mediastinum to the right, first considered to be due to unusual dilatation of the heart.
Fig. 3.   Case 1:   Roentgenogram obtained four months later (August 26, 1942), showing spreading of the paramediastinal consolidation into the lung.

case. In the absence of such lymphadenopathy but in the presence of some of the other varied manifestations of this group, the routine chest roentgenogram may be quite confusing, since these lesions may simulate a wide variety of inflammatory and neoplastic pulmonary and mediastinal diseases.

In these instances we have found the straight lateral view of the chest quite helpful, and we have been able to distinguish a particular group showing retrosternal infiltration with distinct features as an aid to final diagnosis. The two types of lesions noted are:

(1) A soft-tissue mass, "board-like," of even width, ranging from 0.5 to 2.0 cm. in thickness and extending from the level of the diaphragm to the level of the sternoclavicular joint, where it merges with normal soft-tissue structures. It is impossible to determine whether it originates from pleura, subpleural tissue, or periosteum, and it apparently represents a lymphomatous mass.

(2) A pad-like mass—or several similar masses giving a lobulated appearance—also from 0.5 cm. to 2.0 cm. in thickness, convex posteriorly and arranged with the base toward the sternum. The origin and character are similar to Type 1. It is quite possible that this second type represents an earlier stage and may develop into Type 1 by further extension—at least in some instances, as represented by Case 1.

Several of our cases showed retrosternal infiltration as the only manifestation of the disease in the chest during the early period of observation, without any definite involvement of the sternum or presternal edema (Cases 4, 5, and 6). However, in one instance the presence of presternal edema was the factor which led to the search for and discovery of retrosternal involvement (Case 1), and several other of our cases showed concomitant presternal edema.

CASE REPORTS

CASE 1: N. F., a 25-year-old white female, had an enlarged lymph node excised from the right

cervical region and the report of the pathological examination was "Hodgkin's disease."

The early chest films failed to reveal any hilar or mediastinal lymphadenopathy, but there appeared to be an unusual dilatation of the heart to the right (Fig. 2). On later examinations this was considered to be pulmonary consolidation originating from the

Fig. 4. Case 1: Lateral view obtained on same day as Fig. 3, demonstrating consolidation, board-like in character, in the retrosternal area (arrows). The posterior contour of the sternum is indicated by the barbed arrow.

mediastinum and fading out toward the lateral lung field (Fig. 3). Lateral view at this time showed a slightly lobulated retrosternal board-like infiltration (Fig. 4), not recognized as such until it had reached a width of 2.5 cm. The patient, at that time, was complaining of slight retrosternal pain and had brawny edema of the presternal area.

With roentgen therapy there was considerable decrease of the board-like lesion, which finally disappeared completely. In November 1942, however, extensive invasion of the sternum was noticed. This later regressed along with subsidence of the presternal edema (Fig. 5).

Comment: This case is remarkable for the fact that neither in the early phases of the disease, nor throughout the following period of observation, was there any pos-


Fig. 5. Case 1: After several courses of x-ray therapy, the retrosternal mass has disappeared; extensive involvement of sternum is visible. Nov. 22, 1943.

terior mediastinal lymphadenopathy observed roentgenographically. The extensive retrosternal infiltration presented an unusual appearance in the postero-anterior view, and the anterior mediastinal involvement was accompanied by retrosternal pain, presternal edema, and finally by extension into the sternum.

CASE 2: R. M., a 23-year-old white female, was admitted with a history of substernal pain and swelling over the sternum for five months.

The initial films showed a destructive lesion of the manubrium and upper portion of the body of the sternum, of undetermined nature. Biopsy from an axillary node was reported "malignant lymphoblastoma (Hodgkin's type)." The osseous lesion was considered to be of the same nature and was successfully treated with radiation.

A postero-anterior chest film taken after six and a half years, during which time the patient was free of any signs or symptoms, revealed what appeared to be a lymphonodular mass in the right hilar region, but the lateral view showed a half-spindle-shaped mass behind the sternum at the hilar level without
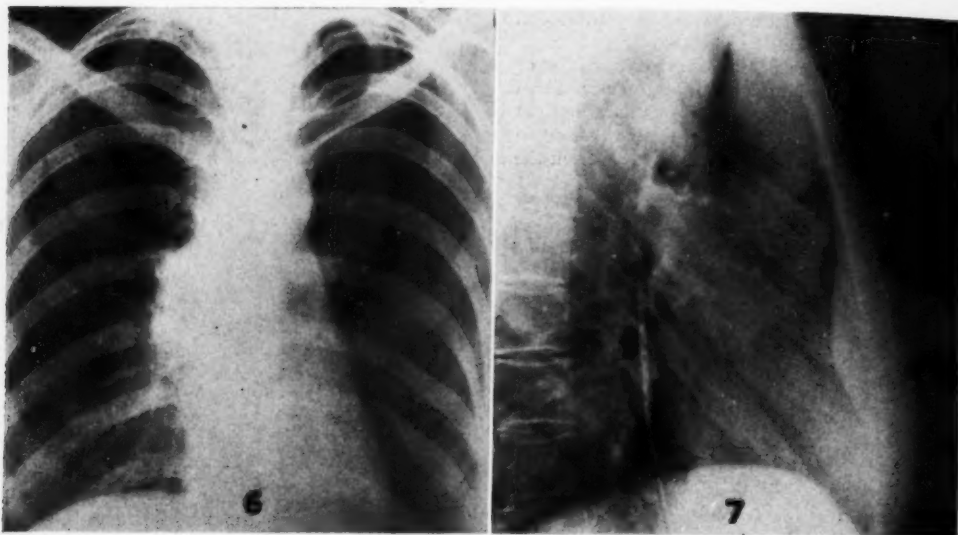
Figs. 6 and 7. Case 2: Malignant lymphoblastoma (Hodgkin's type). After x-ray therapy and freedom from symptoms for more than six years, a half-spindle-shaped mass appeared in retrosternal region.

any gross lymphadenopathy in the posterior mediastinum (Figs. 6 and 7). The sternum failed to show any evidence of abnormality.

Comment: In this case, there was initial involvement of the sternum without a gross retrosternal mass, followed at a later date by retrosternal involvement without any gross osseous lesion.

CASE 3: L. Z., 24-year-old white male, had an enlarged node removed from the right axilla and the pathological report was "Hodgkin's sarcoma."

After radiation therapy, the large mediastinal masses noted in the initial chest film decreased in size, but at re-examination seven months later there was extensive recurrence, with most of the masses visible in the anterior mediastinum and no definite evidence of lymphadenopathy in the posterior mediastinum. A lateral view of the chest revealed a board-like soft-tissue mass behind the sternum (similar to Fig. 4, Case 1), along with extensive edema in the presternal region.

Comment: A case of Hodgkin's sarcoma showing lymphonodular masses, mostly in the anterior mediastinum, along with retrosternal infiltration and presternal edema; without gross x-ray evidence of a sternal lesion.

CASE 4 (Figs. 8 and 9): A. B., 16-year-old white girl, had a cervical node biopsy which was

reported as "malignant lymphoblastoma of Hodgkin's type."

The initial chest films were reported as showing a questionable lymphonodular mass along the trachea on the right, and a large, fairly well defined consolidation—triangular in the postero-anterior view and plump and spindle-shaped in the lateral view—extending outward from the right hilar region. A nodular mass was seen in front of the aortic arch and the interlobar pleura was involved. A soft-tissue mass, 1 cm. in width, was present behind the lower portion of the sternum but was not recognized at that time.

Comment: A case of rapidly developing Hodgkin's disease with unusual roentgen findings, with fairly characteristic retrosternal board-like infiltration and an enlarged node in the anterior mediastinum, two features which may serve to suggest the diagnosis in an earlier stage in other cases.

CASE 5 (Fig. 10): N. C., 51-year-old white male with chronic lymphatic leukemia, showed generalized and mediastinal lymphadenopathy and retrosternal board-like infiltration roentgenologically identical with the changes seen in Hodgkin's disease.

CASE 6: M. S., 26-year-old white female, had a left cervical node biopsy reported as "malignant lymphoblastoma."

The initial chest film was apparently within normal limits but on readmission, three years later,
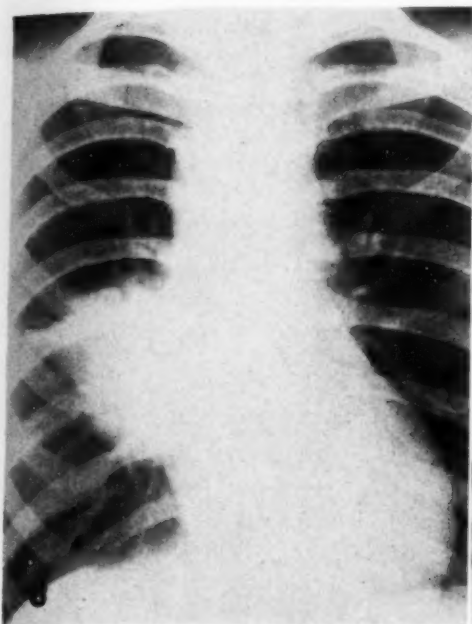
Figs. 8 and 9. Case 4: Hodgkin's disease. This case is characterized by large hilar masses, extension along the interlobar pleura, retrosternally (black arrow), and lymph node involvement in the upper anterior mediastinum (white arrows).

Fig. 10. Case 5: Chronic lymphatic leukemia. Lateral view showing retrosternal board-like infiltration (arrows) identical with that seen in cases of Hodgkin's disease.

there was a lymphonodular mass demonstrable roentgenologically at the right hilum, and in addition a homogeneous obscurity effacing the heart border and fading out laterally into the lung field. The lateral view showed a board-like soft-tissue mass retrosternally, measuring 1.6 cm. in width in its lower portion and 1 cm. behind the manubrium (as in Figs. 4 and 10).

CASE 7 (Figs. 11 and 12): R. Y., 21-year-old white female, had a biopsy from a mass in the neck reported as "malignant lymphoblastoma (Hodgkin's type)."

The postero-anterior view of the chest showed enlarged lymph nodes along the left mediastinal border and in the left hilar region, not distinguishable from lymph nodes arising from the posterior mediastinum. A lateral view revealed that these masses were mainly located in the anterior upper mediastinum. No definite masses were seen in the plane of the trachea.

Comment: A case of lymphadenopathy in the left upper anterior mediastinum.

TECHNIC AND DIFFERENTIAL DIAGNOSIS

Though the retrosternal "board-like" infiltration usually casts its shadow also in the postero-anterior view, it presents itself to best advantage in the lateral chest
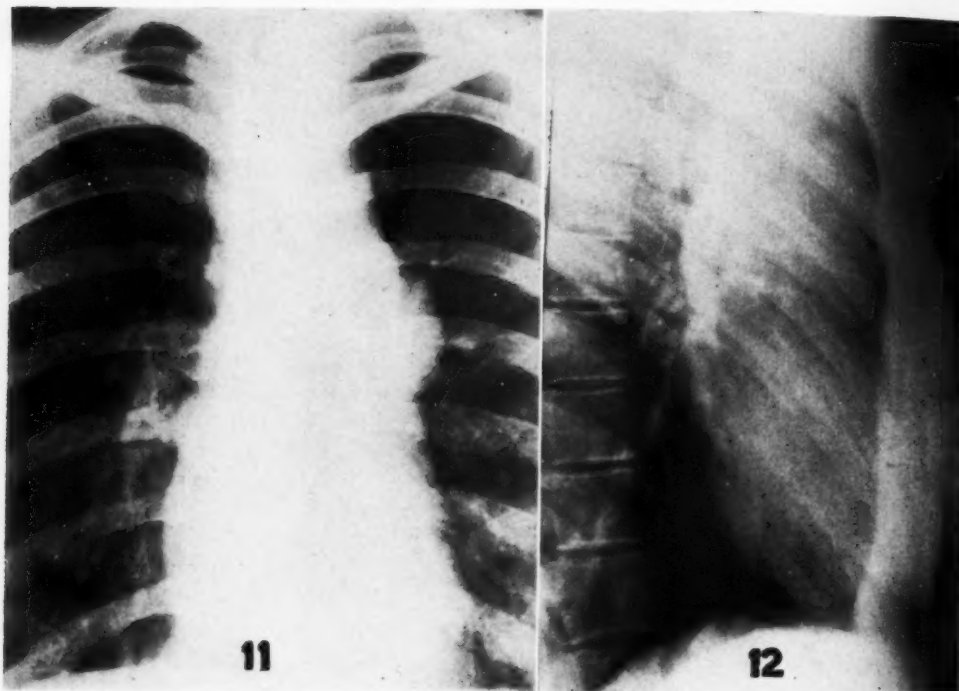
Figs. 11 and 12.   Case 7:   Malignant lymphoblastoma (Hodgkin's type).   The postero-anterior view shows lymphadenopathy on the left not distinguishable from the type usually seen.   The lateral view shows the masses to be located in the anterior mediastinum, their anterior convex contour almost touching the sternum.

roentgenogram. This must be a strict lateral view; moreover, the central beam should be centered quite anteriorly so as to pass tangentially to the anterior chest wall. Though a marked funnel-chest or other gross thoracic deformity will hardly be overlooked, depression of the sternum of minor degree is common and the bulging ribs with their accompanying soft-tissue structures may produce misleading shadows. Another source of misinterpretation occurs in short, obese individuals, in whom the anterior costophrenic angle, particularly on the right, is often not well marked or is even bridged by a soft-tissue mass, possibly an accumulation of fatty tissue similar to the well known "fat-triangle" on the left. This type of soft-tissue mass, however, in our experience, usually has a concave posterior contour and thins out at its upper aspect, never reaching beyond the lower third of the sternum. We do not consider any retrosternal mass limited to

the lower portion of the anterior chest wall to be diagnostic.

Extensive pleural thickening, such as occurs after empyema or chest injury, will manifest itself by more generalized changes, so that any retrosternal component will be recognized as a part of the generalized process. It seems unlikely that inflammatory changes would leave behind such marked thickening merely localized to the retrosternal region.

Of greatest importance for differentiation are the disease entities inflammatory or neoplastic in nature, originating from the anterior chest wall, particularly the bones. Soft-tissue abscesses of any character, incidentally located in the anterior chest wall, may present deceivingly similar pictures; the same being true for the usual osteomyelitides (whether pyogenic, tuberculous, syphilitic, or mycotic), and for primary or metastatic tumors of any nature. Traumatic lesions with or without

subperiosteal abscess formation, particularly when involving the bone, may closely simulate lymphomatous retrosternal infiltration. The distinction from metastatic cancer, especially that originating from the breast, may be particularly difficult, but Ewing's tumor, osteogenic sarcoma, and even a bone cyst can also be confusing.

LYMPHADENOPATHY IN THE ANTERIOR MEDIASTINUM

It is true that inflammatory as well as neoplastic lymphadenopathy of the mediastinum in some cases spares the usually affected nodes and lymphatics of the posterior mediastinum, for unknown reason, and involves the "pre-vascular" nodes. This occasionally causes diagnostic difficulties, and differentiation from aneurysm of the arch of the aorta, thymus tumor, or substernal goiter—to mention a few of the more common problems—is not always easily made. Peirce, Jacox, and Hildreth (6) recognized this problem and noted that the masses cannot usually be localized in the frontal projection, whereas in a lateral view the obliteration of the normally aerated substernal space can be visualized. They emphasize the importance of the lateral chest film in any patient presenting clinical signs or symptoms suggesting lymphoblastoma. While the anterior mediastinal lymphadenopathies they considered present a roentgen appearance entirely different from the cases of retrosternal involvement we have studied, there were two instances in our series in which patients with anterior mediastinal lymphadenopathy went on to show typical retrosternal involvement (Cases 3 and 4). The emphasis on lateral views is further corroborated by our studies.

SUMMARY

1. A retrosternal, "board-like" infiltration has been found in seven instances of malignant lymphoma of the chest, including cases of Hodgkin's granuloma, Hodgkin's sarcoma, and lymphatic leukemia. This lesion is revealed in the lateral chest roentgenogram as a soft-tissue mass behind the anterior chest wall.

2. This lesion may precede any other recognizable changes, particularly those of hilar and posterior mediastinal lymphadenopathy, or may be found in combination with related disease manifestations in the chest.

3. Retrosternal infiltration is often associated with presternal edema and may precede or be found simultaneously with lymphomatous involvement of the sternum.

4. The pathology and roentgen diagnostic implications are discussed.

5. To this report is appended a brief note on Hodgkin's disease with grossly isolated anterior mediastinal lymphadenopathy, the later development of retrosternal infiltration being observed in one case.

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(Spanish summary on following page)

SUMARIO

Infiltración Retroesternal en el Linfoma Maligno

En siete casos de linfoma maligno del tórax, comprendiendo granuloma de Hodgkin, sarcoma de Hodgkin y leucemia linfática, se observó una infiltración retroesternal de aspecto de "tabla." La lesión aparece en la radiografía lateral del tórax en forma de tumefacción de tejido blando detrás de la pared anterior del tórax. Puede preceder las otras alteraciones reconocibles, y en particular las de la linfadenopatía del hilio y del mediastino posterior o puede descubrirse en combinación con manifestaciones patológicas afines en el tórax.

La infiltración retroesternal se asocia a menudo a edema preesternal y puede preceder o acompañar la invasión linfomatosa del esternón. Como frecuentemente se pasan por alto las alteraciones del esternón y dado que en el granuloma de Hodgkin se han encontrado los huesos afectados sin síntomas imputables a patologia ósea, la presencia de infiltración retroesternal puede revelar una invasión esternal existente o inminente. Además, como el roentgenograma que revela el compromiso esternal no es típico de linfoma maligno, la presencia concurrente de infiltración retroesternal puede ayudar en el diagnóstico diferencial.

A esta comunicación se agrega una breve nota sobre la enfermedad de Hodgkin con linfadenopatia del mediastino anterior macroscópicamente aislada. En un caso de este género se presentó después infiltración retroesternal.

Fluoroscopic Image Brightening by Electronic Means

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MORE THAN SIX years have passed since Dr. W. Edward Chamberlain delivered the annual Carman Lecture before the Radiological Society of North America. In this lecture (1), he described in great detail the limitations of present-day fluoroscopy, and held out hope that these severe restrictions might soon be removed, or greatly alleviated, by the application of modern electronic technics to the amplification, or brightening, of fluoroscopic images. Such amplification has recently been accomplished in the Research Laboratories of the Westinghouse Electric Corporation, and it is hoped that before long practical realization of the method for use in clinical fluoroscopy will become available to the radiologist.

There are two reasons why image amplification, or brightening, is necessary if large increases of brightness are to be obtained. First, x-ray intensities are already at the patient's tolerance level and may not be further increased without danger of injury. Second, there is not sufficient energy in the emerging x-rays to form an adequately bright picture even if all the energy were converted into light.

Image amplification has been achieved by converting the x-ray pattern into an electron stream, and accelerating these electrons to high velocities. In this way, energy from an external source is introduced into the system and, when the electrons impinge on a phosphor layer, a brighter image results. This paper deals with the technical aspects of fluoroscopic image amplification, and describes in some detail the mechanism just outlined.

Were it not for the dimness of the image, fluoroscopy would replace to a large extent the taking of roentgenograms. A single fluoroscopic examination would be equivalent to hundreds of films taken in cinematographic sequence and revealing the subject in all phases of movement and from many angles of projection. Unfortunately, however, the fluoroscopic image is excessively dim, and at existing brightness levels the human eye is capable of perceiving only a fraction of the detail which is actually on the screen. Dr. Chamberlain covered this aspect of the problem very thoroughly, and it will suffice to present here only a few aspects of retinal physiology which will serve to illustrate the tremendous ranges of brightness over which the eye is adaptable, and the great loss of definition which is incurred at low levels.

The brightness level at which roentgenograms are ordinarily viewed is roughly 30 millilamberts. At this level, the eye is capable of recognizing as discrete two contours which are separated by as little as one one-thousandth of an inch. As the brightness of the object is decreased, the visual acuity of the eye deteriorates. At about one thousandth of this intensity we have reached the point where cone vision is no longer effective, the color sense is gone, and the fovea centralis is no longer the most sensitive part of the retina. Only rod vision is now present, and visual acuity is such that two contours must be separated by about 1/64 inch to be distinguishable. But we are still a long way from fluoroscopic levels. At a brightness of 0.001 millilamberts (1/30,000 of the brightness of the film mentioned above!) we are in the middle of the fluoroscopic range, and we find the contour separation required is about 1/32 inch.

For the worst cases, *i.e.*, extreme abdominal thicknesses, the brightness may approach 0.00005 millilamberts, and the necessary contour separation 1/4 inch. Even this poor result does not describe the full extent of our difficulty, since it refers to an idealized situation not realized in fluoroscopy. Discrimination between neighboring areas

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is largely a function of the difference in their brightness, *i.e.*, a function of contrast, and contrasts occurring in fluoroscopy are rather low. Whereas a difference in brightness of 1 or 2 per cent proves to be distinguishable at brightness levels used for reading, it may take differences of 20 to 40 per cent to accomplish the same discrimination at fluoroscopic brightnesses. Thus the low contrasts common in fluoroscopic images will result in a further lowering of our visual acuity. The quoted values for needed contour separation above were obtained in measurements where the contour lines separated regions with a contrast of 100 per cent *i.e.*, contours between black and white. Clearly, such separation will be insufficient where the contrast is considerably less than 100 per cent.

Even these poor visual acuities can be acquired only by resorting to long periods (at least twenty minutes) for dark adaptation of the eye. Too short an adaptation time will greatly decrease the ability of the eye to perceive small objects.

Though x-ray equipment is now available which would permit much higher intensities than those used in conventional fluoroscopic equipment, such dosages would be injurious to the patient, whose tolerance to exposure now sets the limitation for attainable brightness of the fluoroscope image. A large increase in brightness without an increase in x-ray intensity, is thus needed to make up for the shortcomings of the viewing eye. While the fluoroscopists, in an effort to improve a desperate situation, would welcome a doubling of the present brightness, increases of an entirely different order of magnitude are necessary to make full use of the information which is actually contained in the fluoroscopic image. To achieve fluorescent images at all comparable to roentgenograms, increases of 100- to 1,000-fold are necessary. It is evident then that we must turn our attention to the x-rays after they have left the patient, and examine the possibilities for converting into a bright visible image the intelligence which they convey.

The present-day fluoroscopic screen is a rather remarkable device. Measurements indicate that it may convert into visible light 30 per cent of all x-ray energy absorbed in the screen. Unfortunately, only about 15 per cent of the incident x-rays are absorbed, the rest passing through without effect. In addition, there is some loss of light within the screen, so that the gross efficiency turns out to be about 3 per cent.

It is perfectly possible that more efficient fluorescent materials may be available in the future, and that some improvement can be made in the absorption. However, a theoretically perfect fluorescent screen would be only about thirty times as bright as the present screens, and it seems unlikely that any material even approaching this figure will be forthcoming. If we wish to achieve gains of 100 to 1,000 there is only one avenue left—the x-ray pattern after it leaves the patient must be used to operate some kind of amplifier which injects into the system energy from an external source.

Before entering into a detailed discussion of how this may be accomplished, it would be well to have assurance that the fluoroscopic image does actually contain sufficient additional information to make amplification profitable. This is by no means obvious. While it is true that fluorescent screens are being used as intensifiers for roentgenograms and succeed in providing a wealth of detail not apparent to the unaided eye, this performance is not in itself a fair basis for drawing a conclusion. The difference lies in the times of exposure. To view objects in normal motion on the fluoroscopic screen, we must present to the eye a complete new image about every twentieth of a second, *i.e.*, roughly the frame period for satisfactory motion picture presentation. Total x-ray exposure during this time interval amounts to 0.05 second $\times$ about 5 ma. (a normal fluoroscopic tube current), *i.e.*, about 0.25 milliampere second. Now a roentgenogram of a normal abdomen may require an exposure of about 80 milliampere seconds. It is a pertinent question whether it is not

over-optimistic to expect comparable quality in the two cases. Actually, there is a good physical reason to suspect that perhaps, under these conditions, the initial x-ray pattern is not complete. The x-rays emanating from the tube are not continuous; as is well known, they consist of quanta or packets of energy, behaving in general as discrete particles. If one had a theoretically ideal x-ray film, and exposed it to x-rays for a very short time, one would expect the developed picture to be made up of small dots, each dot representing the place where an x-ray quantum had struck the film. The dots would be scattered at random over the film, except for greater concentrations corresponding to the thinner portions of the object through which more x-ray quanta had passed. It is seen that this picture would have an incompleteness owing to the quantum nature of the x-rays themselves. No amount of magnification or increased illumination of the film could fill in the missing information.

In practice, this phenomenon is never observed, for our x-ray films have a threshold exposure below which no blackening will take place, and long before this threshold is reached a number of quanta have been collected which is so great that other factors (such as film grain) mask out the quantum "dots." Likewise, fluoroscopic images are so dim that the eye cannot perceive the individual scintillations which really exist on the screen. Nevertheless, if we attempt to amplify the brightness of these images by very large factors, so that the eye is no longer a limitation, we will find that quantum scintillations set an upper limit to the quality of the picture which cannot be exceeded, and one must ask if this limit is not so low as to interfere seriously with our purpose.

This problem was first pointed out by Dr. R. C. Mason of the Westinghouse Research Laboratories, who made a series of calculations as to the magnitude of the effect. This calculation indicated that scintillations would be definitely perceptible at high amplification, but it was very

difficult to estimate the extent to which they would interfere in creating a visual impression in the eye and mind of the observer. An experimental arrangement was therefore set up to test directly the effect of scintillations on the visual acuity and intensity discrimination of the eye. By methods similar to television presentation, a test pattern made up of randomly scintillating dots was projected on the face of a cathode-ray tube. This pattern corresponded to a very weak fluorescent image amplified in brightness by a factor of 10,000. Tests made on several observers showed that the scintillations did interfere to some extent, but that they caused only a small decrease in the effectiveness of image amplification. It is important to keep in mind, however, that this is the fundamental limitation in image amplification, and that any system which does not make the fullest possible use of the available x-ray quanta incurs a deterioration of the image which cannot be corrected by subsequent amplification.

The production of images by the acceleration of electrons from a photosensitive surface was first described by Holst and others (2), who constructed an "image transformer" using this principle. A number of other investigators (3) have contributed to the subject in recent years, and the late war saw an intense development, both in this country and in Germany, of image tubes for use with infra-red illumination.

Of several systems considered, the one which seemed to offer the most advantages is shown in the diagram of Figure 1. A pilot model was first produced as shown in Figure 2. The x-rays are allowed to fall on the fluorescent screen (1), which is mounted in contact with the window in the end of the tube. On the inner surface of this window is a photoelectric layer (2) of the transparent type, that is, light entering the surface from one side ejects electrons from the opposite side. These electrons are accelerated by a high potential placed across the highly evacuated tube, and are focused by a constant magnetic field ap-
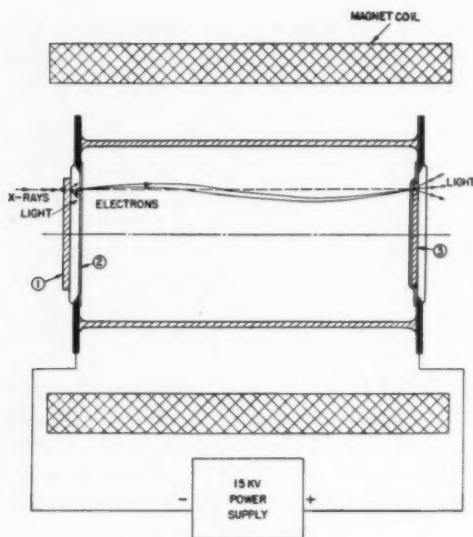
Fig. 1. Diagram of the pilot model operation. X-rays striking the fluorescent screen (1) produce light photons which eject electrons from the photoelectric surface (2). These are accelerated by the electric field from the 15-kv. power supply and focused by the magnetic field of the coil so as to form an image on the output phosphor (3). This image may be twenty times as bright as that from the conventional fluoroscopic screen.

plied axially. The electrons impinge on a phosphor layer (3) on the opposite end, where they form an image identical to the original pattern. If the efficiencies of the fluorescent screen, the photoelectric surface, and the phosphor are high enough, and sufficient accelerating energy is supplied, a gain in brightness will result.

Though this process is simple in principle, its success depends very much on the properties of the materials used. First we must make sure that we utilize as many as possible of the available x-ray quanta, for failure to do so will result in the loss of detail which cannot be restored by any subsequent amplification. Thus we require that the absorption of a single x-ray quantum in the screen ultimately results in the ejection of many electrons from the photoelectric surface. Thirty per cent of the energy of an x-ray quantum may be transformed into light by the fluorescent material. Now this light is also composed of quanta, or photons as they are often

called, similar to the x-ray quanta except that they contain a very much smaller amount of energy per quantum. Specifically, the energy in any quantum is inversely proportional to the wave length of the radiation which it represents. Since the wave length of x-rays in the fluoroscopic range is about 0.2 Angstrom units, and the wave length of the light from the screen is about 5,000 Angstrom units, each x-ray quantum contains 25,000 times as much energy as each light quantum or photon. If the efficiency of the fluorescent process is 30 per cent, about 7,500 light quanta will be generated by a single x-ray quantum. Not all of these light quanta can be utilized, for many of them are lost before they emerge from the surface of the screen. Furthermore, only a fraction of these photons will eject electrons from the photoelectric surface. The most efficient photosurface known, and the one employed in this tube, is a compound of cesium and antimony. This surface, if properly prepared, may have a quantum efficiency of about 1/10, that is, on the average one electron is ejected for every ten incident photons. Taking this loss into account, we end up with an average of about 450 electrons for each initial x-ray quantum absorbed. From a statistical standpoint this is quite satisfactory, for even though the number of electrons ejected will fluctuate somewhat from one x-ray quantum to the next, this fluctuation will not be very large, and we shall be almost certain to utilize effectively each x-ray quantum absorbed.

The electrons thus ejected from the photosurface must be focused to give a sharp image when they impinge on the phosphor at the viewing end of the tube. In the pilot model this was accomplished by the uniform magnetic field from a coil surrounding the tube. Under the influence of the uniform electric accelerating field (supplied by the potential difference between the ends of the tube) and the uniform magnetic field, electrons leaving a point on the photosurface will describe helical paths about a line parallel to the

axis of the tube. These helices, though of varying diameter, will intersect this line at the starting point and again at some other point down the line. By adjusting the relative strengths of electric and magnetic fields, this second intersection may be made to take place at the plane of the phosphor. Thus the paths of all electrons leaving a point on the photosurface converge to a point on the phosphor layer, and a sharp image is produced.

In such a system it is important that the light produced by the output phosphor be prevented from traveling back to the photosurface. If this were not done, an unstable situation might develop, whereby light from the output phosphor would return to produce electrons from the photosurface, these electrons would produce still more light, and eventually the whole system would "run away." This "feedback" can be effectually prevented by backing the output phosphor with an extremely thin membrane of aluminum. The aluminum is made thin enough to permit electrons to penetrate it with little loss of energy, and still be opaque to light. At the same time the aluminum performs two other functions: it brightens the image by returning to the observer light which would normally be lost from the back of the layer, and it maintains the phosphor layer at the desired electrical potential.

The fluorescent screen selected for use in the pilot model is prepared from a zinc sulfide phosphor similar to the type used in screens for miniature radiography. This screen has a very high intrinsic efficiency, and fluoresces in the deep blue and near ultraviolet where the cesium antimony photosurface is most sensitive. The output phosphor is a zinc cadmium sulfide phosphor similar to the usual fluoroscopic screen material, but it has a much finer crystal size. The fluorescent color of this layer is very nearly that for which the eye has maximum sensitivity.

A very great technical difficulty had to be met because of the chemical nature of the materials used in the tube. The zinc sulfide phosphors are very susceptible to
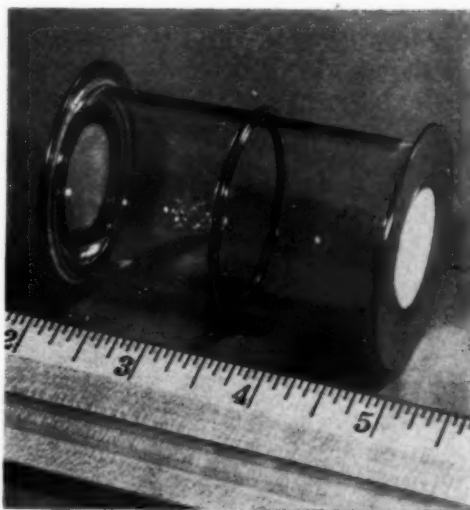

Fig. 2.   Photograph of the pilot model first produced.

impurities, and the cesium vapor used in making the photosurface, being highly active, would attack the zinc sulfide readily. In order to alleviate this problem somewhat, the fluorescent screen in the pilot model was placed outside the tube. The relatively thick glass window separating the screen and the photosurface lowered the resolving power so that the tube was of no practical value, but this did not interfere with measurements of the brightness gain.

Because the color of the first fluorescent screen is not the same as that of the output phosphor, it is of doubtful meaning to quote brightness gains in the tube itself. A more significant procedure is to compare the brightness of the final image on the tube to that of a Patterson "B" fluoroscope screen under the same x-ray conditions. Though this does not measure a unique property of the image tube, it is a direct measure of the practical results obtained. On this basis the pilot model shown in Figure 2 had a measured brightness gain of five times when operated at 13 kv. accelerating potential. The photosurface in this particular tube did not have the high sensitivity which had been attained in some previous experiments.

From these earlier experiments, it was calculated that a properly constructed tube run at somewhat higher potential would be capable of delivering an image twenty times as bright as that from a Patterson "B" screen. Though this is a significant advance, it is still quite a distance from the desired goal. It would, however, be feasible to repeat the process in a second stage similar to the first, and achieve thereby a total gain of 400.

For the model now under construction

ness gained in the electron-optical reduction. There is a limit, of course, to the optical magnification which can be obtained without sacrifice of brightness. In the terminology of optics, the exit pupil of the magnifying system must be kept larger than the pupil of the eye if no brightness is to be lost. As a consequence of this, it turns out that it is not profitable to reduce the size of the electron image to less than one fifth that of the x-ray image, for the contemplated design.
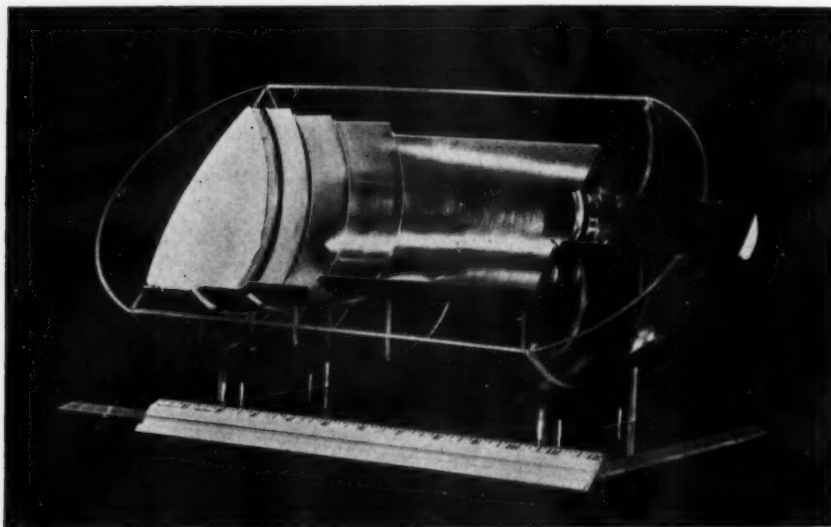

Fig. 3. Cut-away model of the large image tube.

it was decided to make use of a new principle which affords a further factor of 25 in the brightness gain, and brings with it a number of other advantages. If the image size in an electron optical system is reduced, the brightness is increased in inverse proportion to the area. This follows from the fact that all of the electrons are employed in forming the image; if the area is reduced and the total energy remains constant, the energy per unit area (which is proportional to brightness) must go up. Remarkably, if one examines this reduced image through an ordinary optical magnifier, it will appear again in its original size and yet will not lose the bright-

A brightness gain of 25 times is thus introduced by this device. If we combine this with the gain of 20 times due to the electron acceleration process we would have an apparatus delivering a 500-fold brightness amplification.

Such an image amplifier is now being constructed at the Westinghouse Research Laboratories. A cut-away model of the tube is shown in Figure 3 and a diagram outlining its operation in Figure 4.

The envelope of the tube is essentially a glass cylinder 7 1/2 inches in diameter and 15 inches long. Magnetic focusing has been done away with in favor of electrostatic focusing. Each of the metal cyl-

inders shown forms with its neighbor an electrostatic lens. The electric fields between these cylinders act on the electrons in a manner similar to the action of glass lenses on light. Essentially the system consists of one main lens of considerable strength and a series of weak correcting lenses. The fluorescent screen and photosurface are coated on the inside of the curved dish which is five inches in diameter. The electron lens system forms an image on the output phosphor layer which

light-gathering power of the erecting ocular. Actually, the 12×16 screens now employed in fluoroscopy are seldom fully utilized over their entire area. For critical work the x-ray beam is invariably stopped down to include only the object of interest, as this improves the contrast by cutting down the scattered radiation. Moreover, the eye can examine critically only a rather small field of view at one time. For these reasons it was thought best to choose a screen large enough to cover a reasonable
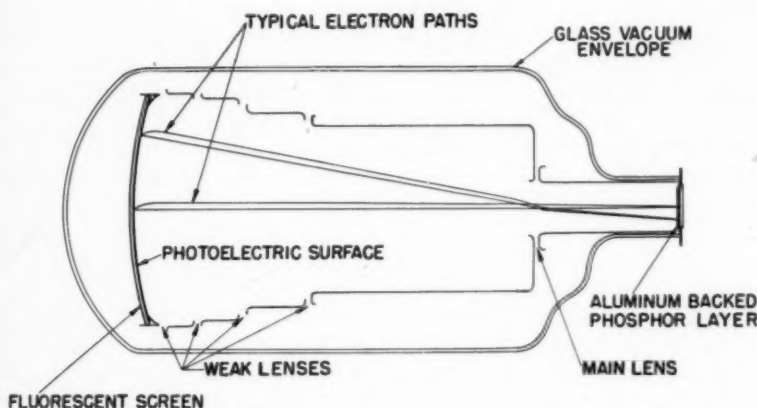

Fig. 4. Diagram of the large image tube. The mechanism of this tube is similar to that of the pilot model (Fig. 1) except that an inverted, reduced image is formed by a series of electrostatic cylinder lenses. The reduction in size produces another factor of 25 in brightness gain, bringing the total gain to 500. An optical magnifier (not shown) restores the size of the image to its original five-inch diameter with no loss of brightness.

is inverted and reduced to one inch in diameter. This is viewed through the optical magnifier, which re-inverts the image and restores it to its original size. The various lens cylinders in the tube are supplied with suitable voltages from a power supply which delivers about 20 kv. at a negligible current. One of the lens voltages is adjustable to permit focusing.

A diameter of five inches was chosen for the field of view as a compromise among many factors. A larger diameter screen would have meant a proportional increase in the length of the tube, and would have added considerably to its bulkiness. Furthermore, it is increasingly difficult to maintain the resolving power of the electron optical system, and the requisite

area but small enough to make the whole tube light and flexible, so that it might readily be moved over the region of interest. The electrostatic focusing system makes light weight construction relatively easy. The entire tube together with its housing, optical system, and protective lead shields, will be light enough to mount in place of the present fluoroscopic screen assembly on existing equipment. The power supply is relatively simple, for the current drain of the tube is only a fraction of a microampere, and a small power supply such as is used in some television receivers will suffice. Only two controls, for optical and electron focusing, are provided, and these will require only occasional readjustments.

With the advent of image amplification, many changes and improvements of fluoroscopic technic will be possible. All procedures now employed are primarily designed for maximum screen brightness attainable. This has often necessitated compromise solutions at the expense of image definition.

One important case in point is the wafer grid, which has proved so useful in radiography because of the increased contrast which it affords, yet which is very infrequently used in fluoroscopy because of the attending loss in brightness. This loss in brightness will no longer be a serious objection if we have at our disposal a brightness gain of the order of 500.

The amplifier will also open up the important field of stereofluoroscopy. Stereoscopic roentgenograms are widely used and play a most important part in diagnostic roentgenology but, in spite of many attempts, no successful stereofluoroscope has ever been built. The physical principles of such machines are sound, and impressive demonstrations have been made using metallic objects at relatively high brightness levels (4). However, with objects of low contrast, and at ordinary fluoroscopic brightness levels, the stereoscopic effect observed is very disappointing. The simple facts of the matter are that stereoscopic vision depends to a high degree on the perception of detail, and rod vision is not competent for this work. At 500 times the brightness, we will in most cases be well within the region of cone vision, and stereofluoroscopy will assume its rightful place as a standard technic of the roentgenologist.

As one of the most striking changes undoubtedly to come, we may anticipate a marked reduction in the time of examination. The increased brightness will permit acquisition of the desired information in a relatively short time. The long observations now necessary to make sure of the absence of certain diagnostic evidence will be in many cases cut short by the immediate appearance of that evidence. This reduction in time, besides being a saving in

itself, will have a very salutary effect on both the patient and the fluoroscopist, for the exposure to direct and scattered x-rays will be similarly shortened. In addition, it might be desirable under some circumstances to relinquish a portion of the brightness gain in favor of reduced x-ray intensities at the skin of the patient. The x-ray kilovoltages and filters used may be modified somewhat, but in general the tendency will be to approach the conditions which produce at present the best roentgenograms.

The necessity for dark adaptation will be considerably reduced. It will still be desirable to dark adapt to some degree, but since under most conditions cone vision will be usable, and the cones in the fovea centralis are nearly fully dark-adapted in three to five minutes, the required time will be markedly shortened.

The apparatus described here is only the beginning of what may be a revolution in the field of radiology. There is no apparent reason why these brightness gains may not be doubled and redoubled many times. With the 500-fold increase in brightness, the image is well within the range of present day television pick-up tubes. This opens up a whole new series of possibilities; the radiologist may be at some distance from the patient, or even in another room, and images may be transmitted and duplicated at different points for observation by several persons. Whatever the fluoroscopes of the more distant future may be like, it appears certain that the new electronic technics will soon place in the hands of the radiologist vastly improved tools for clinical fluoroscopy.

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SUMARIO

Cómo Abrillantar la Imagen Fluoroscópica

Hace varios años el Dr. W. Edward Chamberlain indicó la conveniencia de encontrar algún medio de amplificar, o abrillantar, la imagen fluoroscópica. Tal cosa se ha conseguido, mediante la conversión del *quantum* (unidad elemental) de rayos X a una corriente de electrones, acelerando éstos a elevadas velocidades. En un aparato que se construye actualmente, la corriente de electrones se enfocará electrostáticamente en una capa fosforescente a fin de obtener una imagen reducida, cuya brillantez aumenta en proporción inversa al grado de reducción. Al observar dicha imagen con un amplificador óptico usual, vuelve de nuevo a su tamaño original sin perder su brillantez.

Se espera que la imagen, 500 veces más brillante, obtenible por este método permitirá efectuar exámenes en menos tiempo, disminuyendo el peligro, tanto para el paciente como para el radiólogo, de los rayos directos y esparcidos, y también acortando el período necesario para adaptarse a la obscuridad. Con este método quizás sea práctico emplear las técnicas de la rejilla tipo oblea, la estereofluoroscopia, y hasta tomar películas de las imágenes fluoroscópicas.

Hypervitaminosis A

Report of Two Cases in Infants[1]

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OVERDOSAGE WITH vitamin A causes clear-cut manifestations. Experimental rats given toxic doses of vitamin A (over 15,000 units daily) lose weight almost immediately. Severe emaciation follows. Hemorrhagic rhinitis, loss of hair especially around the mouth, and softening of the bones with spontaneous fractures are fairly constant symptoms. Death occurs usually within two to four weeks. The effect on the blood lipids, serum calcium and phosphorus, and liver function are included in an excellent discussion of hypervitaminosis A by Josephs (1).

Two cases of hypervitaminosis A have been described in children (1, 2). In Toomey's case, the symptoms subsided promptly after discontinuance of vitamin A and recurred with its further administration. In both cases the significant findings included a history of excessive ingestion of vitamin A, anorexia with failure to gain weight, irritability, pruritus, bone sensitivity, sparse hair, dryness and cracking of the lips, hepatomegaly, x-ray evidence of periosteal proliferation, increased level of serum vitamin A, and finally prompt recovery following the elimination of vitamin A from the diet. Reports of two additional cases follow.[2]

CASE I: M. R., a fourteen-month-old male infant, was first seen on June 2, 1947. The complaints were marked anorexia, generalized pruritus, and failure to stand.

Present Illness: At about five months of age, a severe generalized pruritus had developed, without a rash. This persisted and was of such severity that scratching had produced numerous fine scars chiefly on the lower extremities. Irritability and loss of appetite accompanied the pruritus. During the last two months the hair had become sparse.

The child cried frequently after the onset of this illness and would often draw away as if in pain when the wrists were lightly touched. At nine months of age, because of persistent pain, x-rays were taken and were thought at that time (January 1947) to show a fracture of the right clavicle. No previous trauma had been observed. After the shoulder was immobilized, the child appeared more comfortable. Neighbors had commented on the slightly yellow tinge of the skin. Within the last few weeks, the mucous membranes of the lips had become deeply cracked, with slight bleeding.

Past History: The mother's pregnancy had been complicated by an appendectomy between the sixth and seventh weeks. Vomiting was especially troublesome and hospitalization was necessary on two occasions. Delivery was by cesarean section and the birth weight was 7 lb. $2^{1}/_{2}$ oz. The initial evaporated milk formula was satisfactory. Administration of *Oleum percomorphum* was begun at three to four weeks and the dose was gradually increased to one small teaspoon daily at nine months of age. This amount, estimated to contain about 120,000 units of Vitamin A, was continued up to the time when the child was first seen. From the third month on, his appetite was very poor, but he always displayed a remarkable avidity for carrots, squash, egg yolk, and the cod-liver oil preparations. Egg yolk was started at four months. At six to seven months of age, ten drops of Vipenta (5,000 units of vitamin A) were added to the diet. Orange juice was refused but ten to fifteen drops daily of Cecon (1 c.c. contains 100 mg. of ascorbic acid) were given until the last few weeks, when most of this was refused. From eight to fourteen months of age, the daily intake of milk did not exceed 6 oz. Attempts to force feedings created behavior problems.

Mental development was normal. The child talked at ten months of age and appeared quite alert. Physical development was slow. He held his head up between the fourth and fifth months and at eight months could maintain a sitting position for a short time only. He was unable to stand and was just beginning to crawl. The first tooth erupted at six months; five were present at fourteen months.

Infection had been minimal, with a mild diarrhea for three days at four months of age and brief mild respiratory infections at seven and eight months.

Several physicians suggested a variety of dietary regimes, with no appreciable benefit. Vitamin B complex and liver extract had been given intramuscularly for a period of two weeks and slight improvement was observed in physical activity as well as appetite.

Physical Examination: The patient's weight was 20 lb. $^1/_2$ oz. and his height 30 inches. He appeared unusually irritable. The tanned skin was golden yellow in color. Numerous fine scars were present on his legs. The hair was noticeably sparse, but not coarse, with occasional long normal strands. The membranes of the lips were badly cracked.

carotene, 428 micrograms per cent (normal 75–150); blood cholesterol, 177 mg. per cent; serum protein, 7.2 gm. per cent; serum calcium, 7.6 mg. per cent; serum phosphorus, 4.1 mg. per cent; alkaline phosphatase, 11.9 Bodansky units (normal 5–14); Kahn test negative.

Roentgen Findings: Roentgenograms of the entire skeleton were made on June 3, 1947. These disclosed a periosteal reaction, irregular and fuzzy in outline and fading out into the soft-tissue shadow, involving both clavicles and the anterolateral aspects of the ulnae. The greatest width of the periosteal reaction was 3 mm. at the middle of the shaft,
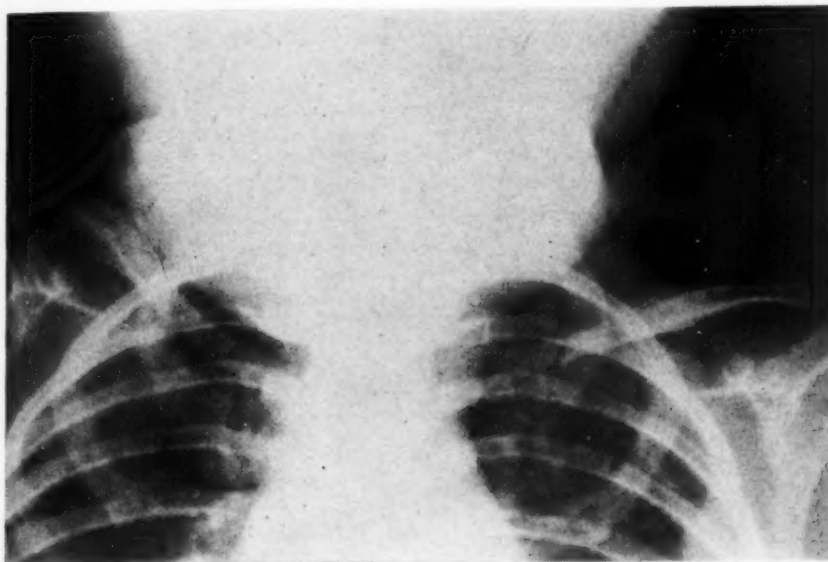

Fig. 1.   Case I: Roentgenogram of clavicles with periosteal reaction most intense at the central areas.

The liver was felt $1^1/_2$ inches below the costal margin. The spleen was not palpable. The child was unable to stand. Otherwise the findings were essentially normal. An examination of the blood three weeks prior to our initial examination showed a mild anemia: hemoglobin 73 per cent; red blood cells 3,640,000; white blood cells 11,800 (polymorphonuclears 24 per cent; small lymphocytes 68 per cent; large lymphocytes 5 per cent; monocytes 2 per cent; eosinophils 1 per cent). Platelets appeared normal on the smear. The urinary findings were within normal limits. Since the history and physical observations corresponded to those in the cases reported by Josephs and by Toomey, a tentative diagnosis of hypervitaminosis A and carotenemia was made.

Laboratory determinations the next day, June 3, 1947, showed: fasting plasma vitamin A, 2,081 international units (normal 76–145 I.U.); plasma

tapering off to blend with the cortex near the ends. The ossification centers for the carpal bones were bordered by a ring of increased density. The spongiosa, the metaphyses, the epiphyseal plates, and the ossification centers in the epiphyses all appeared normal roentgenographically. There was evidence of mild soft-tissue swelling in the muscular bundles overlying the involved long bones.

Roentgenograms on July 10, 1947, five weeks after vitamin A had been withdrawn, disclosed the same bone lesions, now smooth in outline, denser and more mature in appearance. No new lesions were noted.

A review of the roentgenograms taken in another laboratory on Jan. 20, 1947, disclosed a similar periosteal reaction along the central part of the shaft of each clavicle. We were unable to demonstrate a fracture line and inferred that the periosteal reaction may have been interpreted erroneously as callus.

Fig. 2. Case II: Roentgenogram of forearm showing periosteal reaction along the ulna.

Progress: All vitamin A preparations were discontinued. Articles of food high in vitamin A content were omitted or reduced in quantity. Twenty-four days later, the child was standing for the first time and his physical activity had greatly increased. The pruritus had diminished notably. The yellow pigmentation of the skin had faded. The bone sensitivity was no longer present. The appetite was a little better and irritability less marked. The hair was unchanged. Five weeks after the original determinations, the serum vitamin A was 398 I.U. and the plasma carotene was 298 micrograms. Three months later the serum vitamin A was 183 I.U. and the plasma carotene was 226 micrograms.

CASE II: S. S., a 22-month-old girl, was first seen in the outpatient department of the Children's Hospital on April 19, 1946. The complaints were pains in the arms and legs, a peculiarity in gait, anorexia, irritability, increasing fatigue, and a generalized pruritus.

Past History: The child was delivered spontaneously at the eighth month. The birth weight was $6\frac{1}{2}$ pounds. The neonatal period was normal. Breast feeding was discontinued after one week and an evaporated milk formula was substituted. Solid foods were added at two months of age. At about one month of age, 25 mg. of ascorbic acid and 10 to 12 drops of Mead's *Oleum percomorphum* (approximately 1,250 vitamin A units and 180 vitamin D units per drop) were started. Because of a poor appetite and recurrent infections, the daily vitamin intake was increased at ten months of age to 25 to 50 mg. of ascorbic acid, 12 to 20 drops of *Oleum percomorphum*, and 25,000 to 50,000 units of Squibb's vitamin A. Numerous physicians were consulted thereafter and it was difficult to ascertain to what extent the vitamin intake was based on actual prescriptions and to what extent on the mother's enthusiasm for these products. At sixteen months of age the vitamin dosage was increased to 100 mg. of ascorbic acid, 20 to 25 drops of *Oleum percomorphum*, 50,000 to 100,000 units of Squibb's vitamin A, and 3 to 4 capsules of dicalcium phosphate with viosterol. The total daily intake of vitamin A was well in excess of 100,000 units. To this was added three capsules daily of an iron and copper preparation with vitamin B (Copperin B) and 10 to 12 drops of a vitamin B preparation (White's Multi-beta).

At five months of age, the first of a long series of upper respiratory infections occurred. At ten months of age, the child was hospitalized for streptococcic meningitis and recovered without sequelae on chemotherapy and penicillin. Upper respiratory infections, including one severe attack of tracheobronchitis and bilateral otitis media, continued to recur.

Mental development was normal. The child talked at one year of age and appeared alert. Physical development was slow. She walked at seventeen months of age. Only five teeth were present at twenty-one months.

Present Illness: At about eighteen months of age, there were pains in the arms and legs and walking became slow and hesitant. These symptoms grew progressively more severe and the patient seemed unusually irritable. At twenty-one months of age, a diagnosis of scurvy was made at another hospital and intramuscular vitamin C (200 mg. twice daily) was given for three or four days. The daily vitamin intake was again increased to 500 mg. of ascorbic acid, 25 drops of crystalline vitamin D_2 (Drisdol), 100,000 to 150,000 units of Squibb's vitamin A, six capsules of a multiple vitamin preparation (Vitall), six capsules of dicalcium phosphate with viosterol, and 24 drops of White's Multi-beta. The vitamin A intake amounted to approximately 145,000 units daily with 18,410 units of vitamin D. During the following three weeks, the child ate very little, tired easily, and became increasingly irritable. At this time an erythematous eruption appeared on the trunk, associated with a generalized pruritus.

Physical Examination: The patient's weight was $26\frac{1}{2}$ pounds, height 33 inches, head circumference 18.4 inches, chest circumference 19.6 inches, and abdominal circumference 20 inches. She was well developed and did not appear acutely ill. The hair

Fig. 3. Case III (referred to hospital for roentgenographic studies only): Roentgenograms of right forearm (A) and left forearm (B) showing periosteal reaction along the ulnae.

was fine in texture, dry and sparse. The lips were dry and cracked. The skin showed scratch marks and patches of erythema on the trunk. Five teeth had erupted. The liver was firm, smooth, not tender, and extended 1.5 inches below the costal margin. The spleen was not enlarged. Arms and legs were moved cautiously. The hands were held in a position of partial flexion. Walking was hesitant and uncertain. Slight bone tenderness was elicited over the extremities. Examination was otherwise normal.

Laboratory Determinations: The urinary findings were within normal limits. The hemoglobin was 10.6 gm. and the red blood cells 3,620,000. The white blood cells were normal in number and distribution. The Kahn test was negative. There was no reaction to 0.01 mg. of old tuberculin. The serum calcium was 12 mg. per cent, serum phosphorus 5 mg. per cent, and the alkaline serum phosphatase 8 Bodansky units. The ascorbic acid blood level was 46 mg. per 100 c.c. The sedimentation rate (Westergren) was 78 mm. in one hour, dropping to 30 mm. one week later.

Roentgen Findings: Roentgenograms of the long bones revealed a single layer of periosteal proliferation along the posterolateral surfaces of the ulnae, 2 mm. wide at the middle of the shaft and tapering off at the ends. The left clavicle was similarly affected. The hands, feet, and jaw were normal.

The epiphyseal development was within normal limits. Roentgenograms of the lower extremities, made at another hospital one month prior to our examination, were entirely normal.

Progress: The course in the hospital was uneventful, and the child was discharged on the tenth hospital day with the diagnosis of non-specific periostitis. She was seen at regular intervals in the outpatient department. Her condition remained unchanged. Repeat roentgenograms one month later showed no essential change. The following month she was admitted to the hospital for the treatment of a bilateral otitis media and again for a tonsillectomy.

At about the time the child was 25 months of age, Dr. Toomey presented his case of hypervitaminosis A at the Ninety-Fifth Annual Session of the American Medical Association in San Francisco. The similarity in the clinical pictures led to a serum vitamin A determination, which showed a level of 660 international units (normal 76 to 145). All vitamins were discontinued and one week later the child was readmitted to the hospital. The pains in the extremities had disappeared and bone tenderness was no longer present. The examination otherwise showed the same findings as on the previous admission. Serum calcium was 10.6 mg. per cent; serum phosphorus 4.5 mg. per cent; alkaline phosphatase 12 Bodansky units; fasting vitamin A blood

level 194 I.U.; plasma carotene 350 micrograms; blood cholesterol 368 mg. per cent.

The periosteal proliferation along the ulnae and the left clavicle appeared denser and more mature in the repeat roentgenograms.

Preparations containing vitamin A were discontinued, and the patient was discharged from the hospital. The average daily requirements of vitamins C and D were prescribed. One month later the symptoms had largely subsided. The liver was barely palpable. Roentgenograms revealed a normal appearing left clavicle and a slightly thickened cortex on the ulnae at the site of the previous periosteal proliferation. Seven months later, when the patient returned with complaints of stuttering and occasional foot pain, all signs of hypervitaminosis A had disappeared and the hair was more abundant. The mother's enthusiasm for vitamin preparations had not entirely subsided, as she admitted to the occasional administration of a 50,000 unit capsule of vitamin A.

COMMENT

The remarkable similarity between the bone changes in hypervitaminosis A and those in a newly described syndrome, infantile cortical hyperostoses, has been commented upon by Shaw (3) in a discussion of Toomey's report. Clinically, infantile cortical hyperostoses differs from hypervitaminosis A in the absence of a history of excessive intake of vitamin A, the presence of fever, the subacute course with recurrences, the tendency to involve the mandible, and the frequent finding of pleural exudate.

The roentgen picture in both disorders consists of a periosteal reaction most intense at the mid-shaft and affecting multiple bones. Certain differences, however, exist and deserve emphasis. The onset of the majority of reported cases of infantile cortical hyperostoses is in early infancy, although both Smyth (4) and Caffey (5) have reported a few cases in the second and third years of life. Nine cases of infantile cortical hyperostoses have been observed in the Los Angeles Children's Hospital. In all, symptoms occurred before the age of six and a half months. In the cases of hypervitaminosis A reported by Toomey and by Josephs and in two of three cases observed here the children were over one year of age at the onset of symptoms. In

infantile hyperostoses, the mandible is the bone most frequently involved. Seven of our patients had periosteal thickening of the mandible, as did the majority of patients reported by Caffey and by Smyth, except for the few in the older age group. The mandible was not involved in any of the cases of hypervitaminosis A. In the latter disorder, the periosteal reaction has occurred most frequently in the ulnae. Next in frequency of involvement were the clavicles, femur, and tibia in the order named. The clavicles are also frequently involved in infantile cortical hyperostoses. The most significant difference in the periosteal reaction in the two groups is the massive lamellated appearance of the thickening in the older lesions of infantile cortical hyperostoses. More recently affected bones in the same patient have been noted to have a single layer of periosteal thickening. This has been observed in all of our cases as well as in the majority from the literature. In the cases of hypervitaminosis A observed here, as well as in the one reported by Toomey, symptoms had been present for several months before roentgenograms were taken; yet in each case the periosteal thickening was slight when compared with that noted in infantile cortical hyperostoses, and there was no suggestion of lamellation.

Although one of our patients had received little or no vitamin C, no roentgenographic signs of scurvy were manifest. In the first case of hypervitaminosis A reported above an inadequate amount of Vitamin C was received during the last three weeks and possibly a mild degree of subclinical scurvy coexisted. A heavily calcified ring about the ossification centers of the carpal bones appeared in the roentgenograms, yet the ossification centers for the epiphyses were normal, as were the metaphyses, epiphyseal plates, and spongiosa of the long bones. The periosteal reaction was maximum in the mid-shaft in contradistinction to that in scurvy, in which the greatest reaction appears uniformly at the ends of the long bones.

The blood Wassermann or Kahn reac-

tion was negative in all three cases, and no osteochondritis was visible roentgenographically. No evidence of tuberculosis could be found. Most impressive was the prompt improvement that followed the elimination of vitamin A, the fact which verified the diagnosis.

Wolbach (6) has interpreted the bone changes resulting from excessive vitamin A administration on the basis of his experimental work. Guinea-pigs fed 1,000 to 1,250 I.U. of vitamin A per gram of weight showed a rapid maturation of bony growth, with closure of the epiphyses (distal end of femur and proximal end of tibia) within ten to fifteen days, in contrast to the normal rate of twenty to forty-five days. The retardation of linear bone growth was independent of the changes in growth associated with decreased food consumption. Multiple fractures of the long bones occurred within six to ten days and resulted from the extensive loss of previously formed cortical bone before the newly deposited bone acquired sufficient firmness. Periosteal proliferation and resorption of the cortex are considered manifestations of accelerated processes of bone growth.

The capacity of the liver to store huge amounts of vitamin A has been firmly established. In their experiments with rats, Davies and Moore (7) estimated that at the maximum level observed, this vitamin must have constituted 5 per cent of the liver's dry weight and represented a supply sufficient to last the rat for about two hundred years. Again they pointed out that toxic changes may occur while there is still room for a considerably greater accumulation of vitamin A in the liver. Finally, they suggest that the production of hypervitaminosis A does not depend upon the absolute amount of the vitamin contained in the organism but upon ingestion more rapidly than storage can be provided or elimination be brought about.

These experiments on animals have been corroborated by observations on man. Thus, recent studies by Hoffman and his collaborators (8) demonstrate the beneficial effects of restricting carotene and vitamin A in cases of psoriasis vulgaris. Here is additional evidence for the accepted fact "that the blood level of vitamin A is maintained at the expense of the stores in the liver and that the organism is apparently assured an adequate supply of vitamin up to the time when depletion is virtually complete" (9). Employing a diet that restricted vitamin A to 300 I.U. or less, Hoffman observed that plasma vitamin A values remained unchanged over a ten-week period.

These studies indicate that the administration of vitamin A in amounts greater than 5,000 I.U. daily rarely becomes necessary. Aside from the few cases of frank deficiency, the principal indications for increased dosage will be found in individuals with disturbances of fat absorption.

Theoretically, danger of over-dosage must be recognized in conditions characterized by severe disturbance in liver function and in cases of lipemia. An additional risk may pertain to the administration of large amounts of the recently introduced preparations of vitamin A in an aqueous medium. Lewis (10) and Kramer (11) and their collaborators have demonstrated greater absorption of vitamin A when an aqueous dispersion replaces a preparation with an oily base.

The current popularity of vitamins—widely advertised and consumed in great quantity the country over—directs the attention of physicians to the question of their misuse. The report of additional cases of hypervitaminosis A may result in either a reduction in the strength of this vitamin in commercial preparations or the use of a label warning against the dangers of over-dosage. Still other measures may be desirable. To paraphrase a comment made by Josephs: One safeguard we lack is protection of the public against the evangelic zeal of persons who have been sold on vitamins.

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SUMARIO

Hipervitaminosis A. Communicación de Dos Casos

Presentan los AA. dos casos de hipervitaminosis A en niños de 14 y 22 meses de edad, respectivamente, parecidos a los comunicados por Josephs y por Toomey y Morissette. Un enfermito recibía 125,000 unidades diarias de vitamina A y el otro unas 145,000 unidades diarias. Reprodúcense radiografías de otro caso, enviado a los AA. únicamente para estudio roentgenológico.

Los síntomas de la hipervitaminosis A comprenden: anorexia, irritabilidad, prurito, hiperestesia ósea, cabello ralo, sequedad y agrietamiento de los labios y hepatomegalia. Las radiografías revelan reacción perióstica, más a menudo en las clavículas y cúbitos, y de mayor intensidad en el medio de las diáfisis. El aspecto es semejante al de las hiperostosis corticales de los niños. Sin embargo, este último estado suele ocurrir más tempranamente en la infancia y afecta más frecuentemente la mandíbula, va acompañado de fiebre y a veces de exudado pleural, y muestra una evolución subaguda, con recurrencias. El factor diferencial más importante entre los dos estados es el aspecto del hueso atacado. En la hiperostosis cortical infantil el espesamiento toma forma laminar masiva. En la hipervitaminosis A no hay indicio de laminación, y aun cuando los síntomas han durado varios meses, el espesamiento es leve, comparado con el de la otra enfermedad.

La supresión de la vitamina A va seguida de rápida mejoría.

Retroperitoneal Mucocele of the Appendix

A Case Report with Characteristic Roentgen Features[1]

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R ARITY of occurrence and difficulty of diagnosis make mucocele of the appendix an interesting pathological entity. Although there have been more than five hundred cases reported in the literature, only four have been published in which the correct diagnosis was considered before operation or autopsy (4). Until recently, very little has been presented concerning the diagnostic features of this condition (1, 3).

The case to be reported here is of especial interest for the unusual size and the position of the mass. In addition, it illustrates certain characteristic roentgen features that confirm previous roentgen criteria described in the literature (1). In spite of these distinctive roentgen features, demonstrable when appendiceal dilatations attain sufficient size, most physicians are reluctant to accept the preoperative impression based on these criteria. However, mucocele of the appendix may simulate many intra-abdominal conditions, and any aid that may arm the physician adequately to meet the challenge of differential diagnosis is of more than academic significance.

HISTORICAL REVIEW

Mucocele of the appendix as a pathological entity was first recognized and described by Rokitansky (23) in 1842. Virchow (26) considered it next in 1863 as a colloidal degeneration of the vermiform appendix. In 1884, Werth (30) encountered gelatinous material in the peritoneal cavity which was interpreted as being pseudomucin from a ruptured pseudomucinous cyst of the ovary. He ascribed the resultant implantation of the cystic contents onto the peritoneum as "pseudomyxoma peritonei." The term "mucocele" was first used by Féré (5) in 1877.

Original clinical observations on mucoceles were reported by Maydl in 1892 (15), and Lennander in 1893 (12); neither, however, discussed autopsy or operative findings. It remained for Fränkel (6) in 1901 to report the first postmortem study.

INCIDENCE

The rarity of mucocele of the appendix has been established by various excellent surgical and pathological studies reported in the literature (2, 8, 16, 18, 20, 22, 24, 29). The incidence, as computed from the figures reported from these sources, varies between 0.08 and 0.35 per cent.

Age probably has no etiological significance. Most of the reported cases have occurred after middle age, the average being about forty-two years. The youngest patient reported was four years of age (31), and the oldest seventy-eight (6).

Either sex may be affected; the condition is, however, perhaps a little more frequent in the male. Woodruff and McDonald (31) report a ratio of females to males of 1.4 to 1.0. Latimer (11) reported the ratio of females to males as being 1 to 2. In Norment's Mayo Clinic series (20) 61 per cent of the patients were males.

PATHOGENESIS

It is generally accepted that this condition begins with an inflammation of the appendix. There may be one attack, or a repeated number of inflammatory episodes. In any event, the process causes a stricture

or obstruction of the appendiceal lumen (31). Usually the lumen is patent distal to the occlusion, and the secretions of the appendiceal mucous membrane are trapped within this space. The continued collection of supposedly sterile secretion in this closed lumen produces the characteristic distention of the appendix.

As the process progresses, the walls of the organ are distended by the gradual accumulation of gelatinous material. Pressure within the closed viscus may increase sufficiently to cause protrusions of the mucous membrane through the muscular coat, and produce diverticula just beneath the peritoneum. At any point in its development, one of the diverticula might rupture and discharge its contents into the peritoneal cavity.

It has been the contention of most authors that, in the event of rupture into the abdominal cavity, pseudomyxoma peritonei could result. Woodruff and McDonald (31) however, presented evidence to refute this belief, and ascribed the malignant complication only to cases originating from "carcinomatous cystadenoma" of the appendix.

Grossly, the size of the mucocele may vary from a slightly localized enlargement of the appendix to a globular mass 10 cm. or more in diameter (17). The largest mucocele recorded in the literature was reported by Neumann (19), who described it as being "as large as a man's head." The shape may vary according to the size and position of the cystic areas. Kelly (10) described one the size and shape of a banana, curved at its base and 30 cm. in length. The color ranges from normal to grayish white. The mass may be of normal softness or quite firm as a result of distention. Both hyaline and calcific changes may be found in the cyst walls.

Histologically, various descriptions have been recorded; these probably represent various stages of the same pathological process. The walls of simple mucoceles vary from almost normal mucous membrane to a thin hyaline membrane practically devoid of lining epithelial cells (31).

The contents are usually somewhat thick and mucoid; a true hydrops, in which the content is watery, is rare. The material may give a chemical reaction for either mucin or pseudomucin.

CLINICAL FEATURES

The symptoms of mucocele are vague and indefinite. There may be complaints of mild abdominal distress, dull pain, or discomfort in the right lower quadrant of the abdomen. The majority of patients give a history of previous appendiceal attacks. Sometimes, when the mucocele has become sufficiently enlarged, there are complaints of both pressure symptoms and a mass in the right lower quadrant.

A tabulation of the signs and symptoms from the literature reveals that the most frequent complaint is of pain and tenderness in the right lower quadrant. The second most common finding is a palpable mass at the same site. Pain in the epigastrium has frequently been recorded, and in one instance it was listed as the first and most common symptom.

DIAGNOSIS

The limited symptomatology and the rarity of the condition, with its infrequent consideration as a possibility, probably account for the low incidence of preoperative diagnosis. However, a past history of single or repeated attacks of appendicitis, indefinite abdominal distress or pain in the right side, with a fixed or movable mass present at the site, may suggest such a condition. There may be referred somatic pain or radiation into the medial aspect of the thigh. Occasionally, the patient may present signs and symptoms of an acute surgical condition with fever and leukocytosis.

ROENTGEN FEATURES

Roentgen rays were focused on this condition as early as 1915 by Ogilvie (21), who stated that the roentgenogram only "clouded the picture of the case." Timoney (24) states that LeWald (13) may have been the first to interpret the roent-

gen findings accurately in 1920, in a case which was presented before the New York Academy of Medicine, but which was not published. Vorhaus (27), in 1930, was able to secure roentgenograms of a barium-filled mucocele of the appendix and establish a preoperative diagnosis.

The general use of roentgenography in appendicular mucocele has, however, been quite limited, due to the fact that there is invariably almost complete obliteration of the proximal lumen of the appendix. Rarely is it sufficiently patent to permit passage of the opaque medium and allow visualization of the enlarged cyst. In addition, the fully distended mucocele would prohibit entrance of any opaque medium and obviate direct visualization.

There are, however, certain anatomical features of the disease which permit changes that may render it susceptible to roentgen diagnosis. If the mucocele enlarges sufficiently, it will produce significant displacement and pressure deformity of the cecum. In addition, calcific deposits in the substance of the mass and in the cystic wall are frequently observed and will assist roentgen study (4).

Åkerlund (1), in 1936, in an excellent study, correlated the anatomical changes with the roentgen features in a review of two cases in which roentgenograms were available. He emphasized the extrinsic pressure defect on the barium-filled cecum and its displacement as indirect signs, indicative of the presence of a mass.

Jutras offered further support to Åkerlund's contention in a study presented in 1938 (9). Goinard et al. (7), in 1939, presented a case with characteristic roentgen features, but the preoperative diagnosis was "benign mass." Later in the same year, Varela-Fuentes et al. (25) reported, from Montevideo, the first instance of a correct preoperative diagnosis based on Åkerlund's postulates. The unique case presented by Vorhaus (27) in 1930 was the second example of a correct preoperative diagnosis. A third was recorded by Lifvendahl and Ries (14) in 1932, and the fourth was reported recently in an excellent study

by Euphrat (4). This last author re-emphasized and outlined the roentgen criteria enumerated by Åkerlund.

DIFFERENTIAL DIAGNOSIS

Mucocele of the appendix could be considered in any of abdominal diseases associated with pain and a palpable mass, especially in the right lower quadrant of the abdomen. The diagnosis definitely requires differentiation from the conditions most frequently confused with it, such as kidney tumor, gallbladder involvement, ovarian cyst, appendiceal abscess, pyogenic abscess of the peri-appendicular tissues, retroperitoneal tumor, intrinsic tumor of the cecum, and urinary calculi.

TREATMENT

The treatment is entirely surgical and varies from a simple appendectomy, or extirpation of the mass, to a more extensive cecal or ileocecal resection. In a mucocele that has ruptured, removal of the mucoid gelatinous material may be sufficient. If malignant degeneration is suspected, radiation therapy postoperatively may be of some value (24). However, the efficacy of x-ray therapy has not been definitely established.

CASE REPORT

R. B., a 37-year-old white male, was admitted to the Wadsworth General Hospital as an ambulant patient on April 6, 1947. His chief complaints were (1) pain and tenderness in the right lower quadrant of the abdomen, (2) a progressively enlarging mass in the right side, of three years duration, that had suddenly undergone rapid expansion during the past twelve days, and (3) fever, chills, and generalized aching for about the same period.

The pain radiated occasionally into the groin and medial aspect of the right thigh. The patient had experienced no nausea or vomiting, and only moderate anorexia on the day of admission. There had been no diarrhea, but a moderate constipation was noted. Two irregular episodes of nocturia with mild burning at micturition had occurred.

The past history disclosed that, at the age of eleven, the patient had "an acute attack of appendicitis," but the appendix had not been removed because of a "lack of surgical facilities" in his home town. While in Hawaii, in 1944, he was admitted to a Naval Hospital because of a cutaneous allergy, his first hospitalization since his illness in childhood.
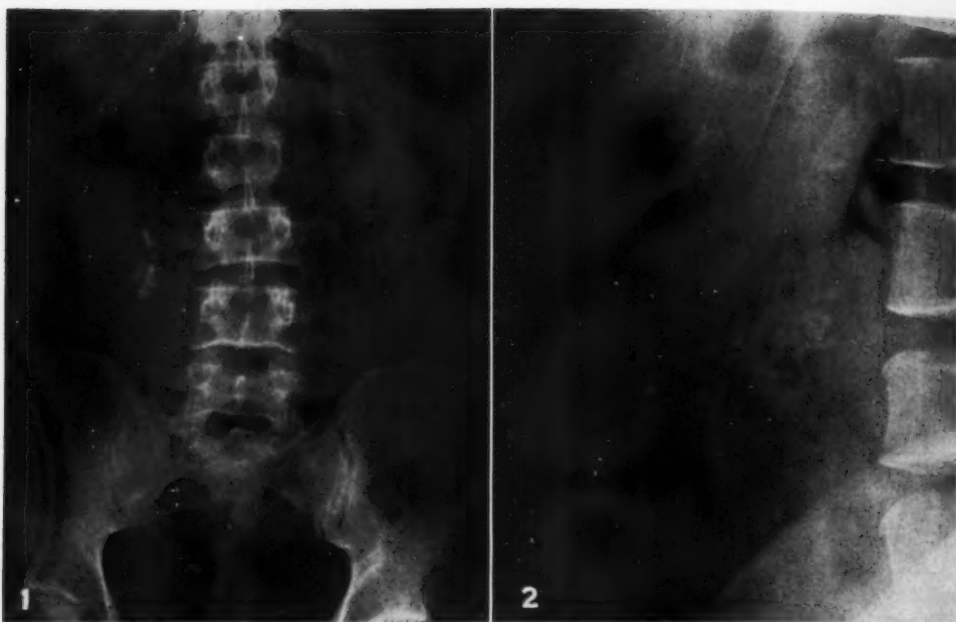
Fig. 1. Anteroposterior roentgenogram of the abdomen revealing large soft-tissue mass, with central annular pattern of calcific deposits, in the right lower quadrant.

Fig. 2. Right lateral roentgenogram of the abdomen demonstrating the calcific deposits anterior to the spine and extending forward compressing distended bowel against the abdominal wall.
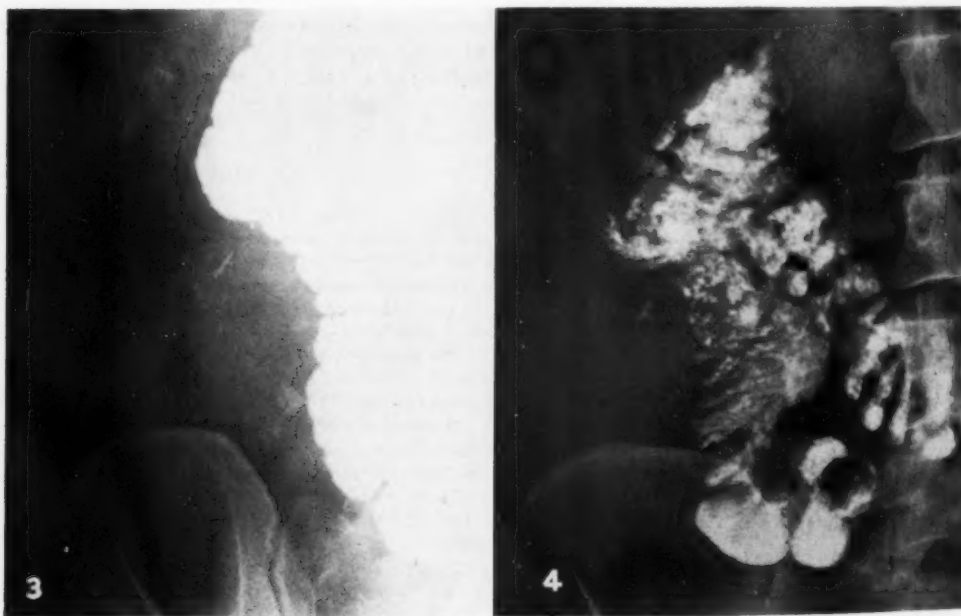

Fig. 3. Barium enema study, right anterior oblique projection, showing mass with central calcifications displacing the cecum and ascending colon medially and anteriorly, and the resultant concave compression deformity.

Fig. 4. Post-evacuation roentgenogram, anteroposterior projection, demonstrating medial displacement of colon and cecum, and "figure-3" defect along the lateral margin of the cecum.

During the routine physical examination, the physician noted a small oblong mass, about the size of an index finger, in the right lower quadrant of the abdomen. The mass was only slightly tender then, and although the patient was aware of its presence he disregarded it, and it was never investigated further.

Physical Examination: Examination revealed a marked bulging of the right lower abdomen extending from the flank to the mid-line. Palpation outlined a large, ill defined, fairly firm mass, extending from the right groin to the right costal margin, and from the right flank posteriorly to the mid-line anteriorly. It was only slightly movable, and respiration did not alter its relative position.

Maximum tenderness was elicited between the right flank and right costovertebral angle. There was only moderate inguinal tenderness, and no rebound pain was obtained. Rigidity was questionable due to the right-sided enlargement. Auscultation revealed no alteration or intensification of the abdominal borborygmi. The left side of the abdomen was entirely negative.

Rectal examination was unaccompanied by pain or tenderness, but gave the sensation of a firm, resistant mass just below the brim of the pelvis on the right side.

Laboratory Data: The urinalysis was entirely normal. The erythrocyte count was 4,050,000, with hemoglobin 79 per cent (Sahli). The leukocyte count was 20,800 with 81 per cent polymorphonuclear neutrophils. Blood serology was negative, and the sedimentation rate within normal limits.

Radiological Study: On admission, the anteroposterior roentgenogram of the abdomen (Fig. 1) revealed an ill defined, homogeneous area of increased density, partially obscuring the roentgen features of the entire right side of the abdomen. The silhouette of the lower pole of the right kidney and the lower two-thirds of the psoas muscle shadow were obscured by this opacity. Numerous amorphous, and linear calcific deposits arranged in a circular pattern occupied the central portion of the area. The lumbar spine showed a moderate scoliosis with the concavity on the affected side. There was an approximation of the costal margin and the crest of the ilium on this side. The ascending colon, visualized by its gaseous distention, appeared displaced toward the spine.

The right lateral roentgenogram of the abdomen (Fig. 2) located the concentrically arranged calcific deposits anterior to the spine shadow, and centered at the level of the 3d lumbar body. This circle of calcified particles measured about 10 cm. in diameter, and extended from the anterior border of the lumbar spine anteriorly against distended bowel, which appeared displaced and compressed against the abdominal wall.

An upper gastro-intestinal examination was entirely normal. The barium enema revealed no abnormality of the colon until the proximal portion of the ascending colon was reached. At the cecocolic junction, the proximal ascending colon and cecum filled easily but presented a concave compression deformity extending along the lateral border, with medial displacement of this segment. This appeared to be due to the presence of a fairly large, firm mass that was palpable in the right lower quadrant of the abdomen (Fig. 3).

In the right lateral and oblique positions this segment of colon and cecum showed concave depression deformity and displacement anteriorly and medially away from the lateral abdominal wall. The mass was fixed, and the cecum appeared incorporated in its medial aspect. An irregular marginal deformity of the inferior border of the cecum was noted. Numerous small amorphous shadows were faintly visible within the homogeneous density of the mass. The appendix was not outlined, and reflux into the small bowel was not obtained.

The immediate radiographs (Fig. 3) confirmed the fluoroscopic findings and demonstrated the concave compression of the cecum and proximal ascending colon, with displacement of this segment anteriorly and medially toward the spine.

The post-evacuation film (Fig. 4) showed an irregular "figure 3" defect along the inferior-lateral border of the cecum. The mucosal pattern of the cecum and colon showed no alterations and appeared intact.

Excretory urograms revealed prompt excretion and good visualization of the calices and pelves of both kidneys. Both ureters were outlined throughout their extent. The left kidney was entirely normal.

The right kidney silhouette was obscured in its lower third, but the upper two-thirds were normal in configuration and position. The superior and middle major calices as visualized presented no significant abnormalities. However, the inferior portion of the collecting system showed a concave pressure deformity. This was manifested by compression and cephalad displacement of the inferior major calix and inferior aspect of the renal pelvis (Fig. 5). The minor inferior calices, also, appeared displaced and compressed to a lesser degree. There was a minimal elongation of the infundibula of these calices. A slight kink of the ureter was evident in the proximal portion immediately distal to the ureteropelvic junction.

The roentgen studies were interpreted as evidence of an extra-renal cystic mass that was compressing the inferior pole of the right kidney and intimately compressing and displacing the cecum and proximal colon.

Lipiodol, instilled through the sinus tract resultant from the first of the two operative procedures (see below), under fluoroscopic control, outlined the cecum and ascending colon (Fig. 6).

With the results of these studies, it was the majority opinion that the most likely possibility was mucocele of the appendix. However, due consideration was still given, by the minority opinion, to the

Fig. 5. Excretory urogram, anteroposterior projection, showing compression and cephalic displacement of the inferior portion of the collecting system of the right kidney.

possibility of a retroperitoneal neoplasm or possible tumor of the cecum.

Operative Findings: Operation disclosed a firm, thick, white-walled cyst which presented downward into the right iliac fossa and reached upward into the right hypochondrium. Approximately 500 c.c. of a thick, gelatinous mucoid substance was evacuated. It was of a homogeneous yellow color with an odor not unlike amniotic fluid. A considerable amount of hard, calcareous material was scattered throughout the substance. The same gritty calcareous material was deposited diffusely throughout the thick wall of the cyst. The cyst was later removed *in toto* in a two-stage operative procedure.

Microscopic study of a section of the cyst wall obtained at the first operative procedure showed it to consist of a very thick connective tissue lined by pyogenic membrane. No specific pathological diagnosis was made at that time.

After the second-stage operative removal of the cyst, the surgical specimen was described by the pathologist as an irregular rounded mass measuring 11 × 11 × 8 cm. A portion of skeletal muscle was attached to one side, externally, and a segment of the proximal appendix projected from the opposite side. On the inner aspect, the specimen showed an extensive area of cystic, mucus-lined tissue, which was covered with thick, yellowish-green mucoid material.

The microscopic sections reviewed revealed an abundant mucous material, with marked neutrophilic and round-cell infiltration of the substance. Abundant fibrous tissue proliferation and replacement had involved all the layers of the mucosa, submucosa, and muscularis mucosae, and left only what appeared to be markedly thickened, fibrous appendiceal wall. There were numerous papillary projections extending from the inner surface, which were surrounded by conglomerations of mucoid substance. Throughout this substance were scattered irregular areas of calcific deposits.

Fig. 6. Anteroposterior roentgenogram, following the instillation of lipiodol through the sinus tract in the right flank, showing the opaque medium outlining the cecum and ascending colon, and visualizing the sinus tract of the appendico-cutaneous fistula.

Final Diagnosis: (1) Mucocele of appendix; (2) appendico-cutaneous fistula, with sinus tract formation, and extensive chronic granulation tissue.

SUMMARY

Rarity of occurrence and the difficulty of diagnosing mucocele of the appendix have made it a constant challenge to the acumen of the physician since the condition was first recognized as a pathological entity. Up to now little has accumulated in the literature to contribute to the preoperative diagnosis, and only four

cases have been published in which the correct diagnosis was considered before operation or autopsy.

Åkerlund in 1936 correlated the anatomical findings with the roentgen features observed in two proved cases of mucocele of the appendix. More recently, Euphrat (4) in an excellent article re-emphasized and enumerated the roentgen criteria presented by Åkerlund.

A diagnosis of mucocele of the appendix is suggested if the roentgen examination discloses a fairly well circumscribed, globular or reniform shadow or mass in the cecal region, with displacement of the cecum or adjacent parenchymatous organs medially. Recognition of calcium deposits within the wall or substance of the mass adds supplementary evidence. Additional findings, such as marginal cecal deformity and failure to establish the patency of the appendiceal lumen, are supportive, but not essential.

A case of unusually large retrocecal mucocele of the appendix is reported, in which a correct preoperative diagnosis was indicated by the roentgen features.

NOTE: This case is presented with the permission of Dr. C. W. McClanahan, Chief of the Radiological Service, V. A. Center, Los Angeles, Calif. The authors wish to express their thanks to Dr. K. S. Davis, Chief Consultant, for his counsel and interest.

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(Spanish summary on following page)

SUMARIO

Mucocele Retroperitoneal del Apéndice. Historia Clínica con Típicas Características Roentgenológicas

La rareza y difícil reconocimiento del mucocele del apéndice lo han convertido en un reto constante a la agudeza diagnóstica del médico para reconocerlo como entidad patológica. Hasta ahora poco se ha acumulado en la literatura que ayude al diagnóstico preoperatorio, y sólo se han publicado cuatro casos en los que se considerara el diagnóstico acertado antes de la intervención o la autopsia.

Åkerlund in 1936 correlacionó los hallazgos anatómicos con las características radiológicas observadas en dos casos comprobados de mucocele apendicular. Más recientemente, Euphrat (4) volvió a recalcar y enumerar en un trabajo excelente las pautas roentgenológicas.

Hay que pensar en un diagnóstico de mucocele del apéndice si el examen radiográfico revela una sombra o tumefacción globular o reniforme, bastante circunscrita, en la región cecal, con desplazamiento hacia el medio del ciego o los adyacentes órganos parenquimatosos. El reconocimiento de depósitos de calcio en la pared o sustancia de la tumefacción aporta datos complementarios. Otros hallazgos, tales como deformidad de los bordes del ciego e incomprobación de la permeabilidad de la luz del apéndice son corroboratorios, pero no esenciales.

Comunícase un caso de mucocele retrocecal del apéndice, extraordinariamente grande, en el cual las características radiológicas indicaron el diagnóstico preoperatorio acertado.

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Mobile Calcified Choroid Plexuses

A Case Report[1]

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THIS REPORT IS being offered because of the absence of previous reference in the literature to mobile choroid plexuses which, when calcified, may result in asymmetrical relationships demonstrable in the roentgenograms. The matter is of importance, since significant displacement of the choroid plexus is a sign of an intracranial space-occupying lesion (1, 3, 6–9).

Calcification of the choroid plexus of the lateral ventricle is considered to be physiologic, as are calcifications of the pineal body, falx cerebri, and pacchionian bodies. Its frequency is in proportion to age and has been variably reported as from 6.1 per cent to as many as 28 per cent of all persons over twenty years of age (1–4). The calcification is usually limited to the glomus of the choroid and is quite characteristic, being likened to a popped kernel of corn or to a cluster of glass beads (5). It occurs bilaterally in most instances. When unilateral, the clustered circinate shadows of the choroid plexus will distinguish it from a displaced pineal gland, which has a more irregular group of calcific shadows.

It is generally felt that the normal position of the glomus of the choroid plexus of the lateral ventricle is relatively fixed. The two calcified glomi have been described (10, 11) as forming an isosceles triangle with the pineal body in anteroposterior roentgenograms: the pineal body, below, constitutes the apex, while the calcified glomi are at the other angles, situated symmetrically, bilaterally, approximately 5.0 cm. apart and 0.5 cm. above the level of the pineal. Complete superimposition of the glomi is the exception rather than the rule in the lateral view, due to slight distortion resulting

from the divergence of the x-ray beam, which, in a perfectly true lateral projection, would cast the shadow of the glomus farthest removed from the film, posteriorly. A slight fault in the alignment of the head, too, would cause a relatively significant shift in the relationship of the two glomi.

Little has been recorded concerning displacement of the calcified glomus as seen in the plain roentgenogram, though a few references have been found relating to faults in roentgenographic technic as noted above, or to an intracranial lesion. Wood (8) and Jacobsson (9) indicated that varying degrees of asymmetry of the triangular relationship of calcified choroid plexuses and the calcified pineal gland may occur without organic disease. The latter stated that the changes must be gross before they can be considered indicative of an intracranial expanding lesion. He attributed the asymmetry in normal persons to asymmetrical distribution of the calcium in the choroid plexuses. Newell (6) noted one instance in which the choroid plexus was displaced downward by pressure of a cerebral tumor. Lowman and von Storch (7) described displacement of the choroid plexus by what was thought to be a localized cerebral hemorrhage, with subsequent return to a more normal position, but no operative or autopsy confirmation as to the type and site of the lesion was offered. A. E. Childe (3) reported eight cases of displacement of the choroid plexus by intracranial expanding lesions. Five of the patients had corresponding displacement of the calcified pineal body. In two of the other three cases there was no calcification of the pineal bodies and in the third the location of the calcified pineal body fell within the normal zone. In each of these
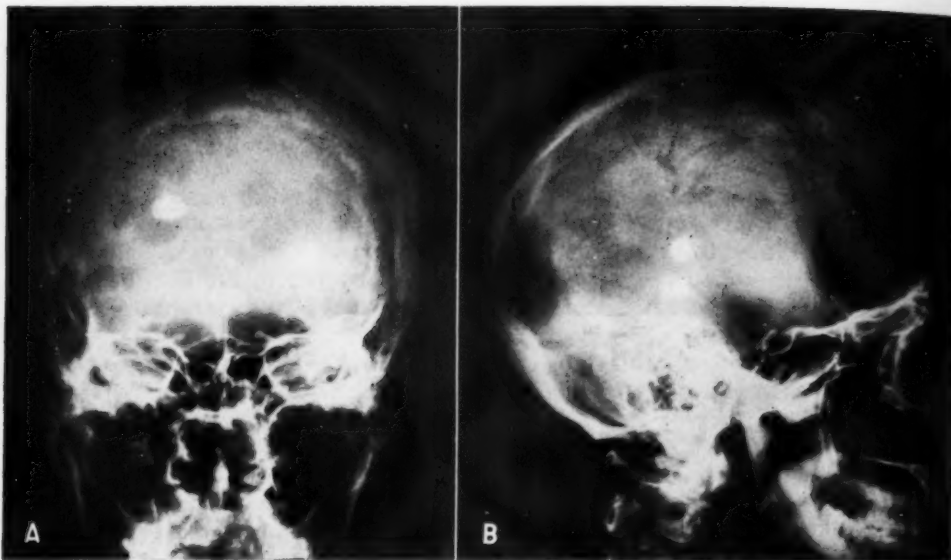
Fig. 1.   A.   Postero-anterior projection of skull in prone position showing depression of left calcified glomus of choroid plexus of lateral ventricle.   Dec. 4, 1944.   B.   Lateral view in left decubitus position taken at same time.

three instances the only manifestation of an intracranial expanding lesion in the plain roentgenogram was the effect upon the calcified choroid plexus.

CASE REPORT

Mr. O. S., age 36, was first seen here in September 1944 because of vomiting and headaches.   He had sustained a severe head injury in 1929 and was unconscious for three days.   Roentgenograms of the skull made at that time, but not available, were reported to show separation of the lambdoidal suture line and the squamoparietal suture on the left side. A calcified mass, approximately 1 cm. in diameter, was recorded as being present in the right side of the brain in the region of the temporal lobe.   The patient had since that time had intermittent headaches, often associated with nausea and vomiting. The headaches were generalized and steady.   In the past year there had been two episodes of fainting, but at no time had convulsions occurred.

Roentgenograms of the skull were made in 1934 and 1937.   These are not available.   On both occasions bilateral calcifications of the choroid plexuses were noted.

Physical and neurological examinations were normal.

The first examination of the skull made here, Dec. 4, 1944, demonstrated two calcific shadows characteristic of calcified glomi of the choroid plexuses of the lateral ventricles.   These were notably asymmetrical in position, the calcific shadow on the

left side being considerably depressed relative to that on the right (Fig. 1).   The pineal body, which

Fig. 2.   Postero-anterior projection of skull in prone position demonstrating depression of right calcified glomus of choroid plexus.   Aug. 27, 1945.
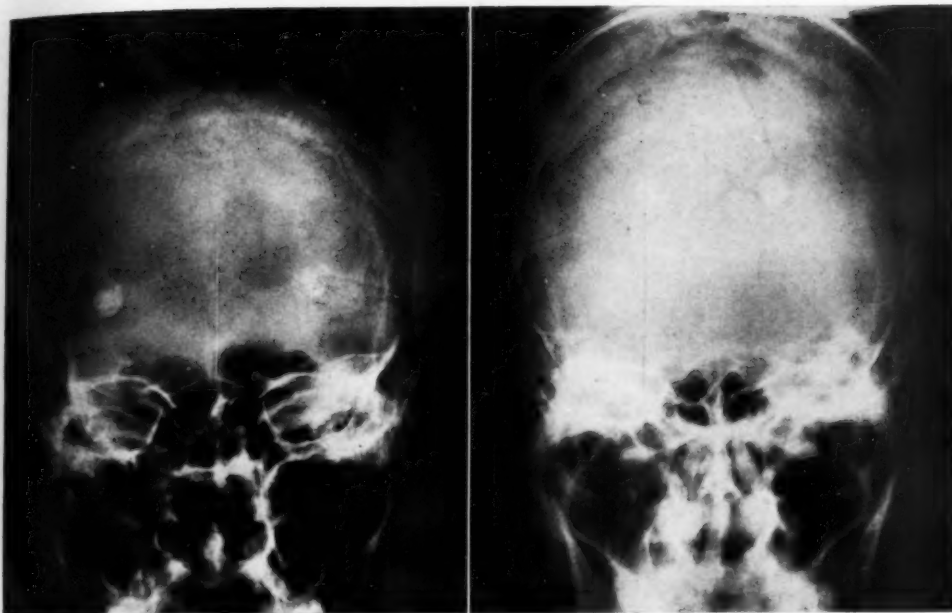
Fig. 3 (left).   Postero-anterior projection of skull in upright position.
Fig. 4 (right).   Postero-anterior projection of skull in deep Trendelenburg position.

could be seen in the lateral view, could not be definitely made out in the anteroposterior projection. Because of the marked asymmetry of the calcification, the possibility of a space-occupying lesion above the left choroid plexus was suspected.

Re-examination of the skull on Aug. 27, 1945, showed an amazing change. At this time there was depression of the right choroid plexus, with relatively normal location of the left (Fig. 2). The picture was the reverse of that previously seen, though with a greater degree of depression of the right choroid plexus than of the left in the original study. The possibility of mobility of the glomi was then considered, and multiple studies were performed. Postero-anterior projections of the skull were obtained in the upright position (Figs. 2 and 3), in deep Trendelenburg position (Fig. 4), and with the patient prone, rotating the head from the right lateral position and then from the left lateral position.

Subsequent to this a pneumoencephalogram was obtained. There was no displacement of the midline structures. Once again, the freedom of movement of the calcified choroid plexus within the lateral ventricle was demonstrated (Fig. 5). In several of the pictures there was a suggestion of a small pedicle extending from the right calcified glomus to the remainder of the choroid at the limbus.

Comment: The roentgen studies revealed that the patient had calcified glomi of the choroid plexuses of the lateral ventricles which responded to the forces of gravity. In the upright position both would descend into the temporal horns of the lateral ventricles (Figs. 3 and 5—*1* and *1'*). Due to the position of the temporal horns, these calcifications would necessarily move caudad and laterally. In the deep Trendelenburg position they would move into the bodies of the lateral ventricles (Fig. 4), the direction of motion necessarily being cephalad, mediad, and anteriorly. In the supine position they would fall posteriorly into the rudimentary occipital horns (Fig. 5—*3* and *3'*). With the left side down, the left choroid plexus would gravitate into the temporal horn, moving caudad and laterad, and the right choroid plexus would enter the body of the lateral ventricle, moving cephalad and mediad. In this position the left choroid plexus would be inferior and the right superior. When from this position the head was rotated to the prone position, the right choroid would remain in the temporal horn and also move anteriorly. This would correspond to the relationship pres-
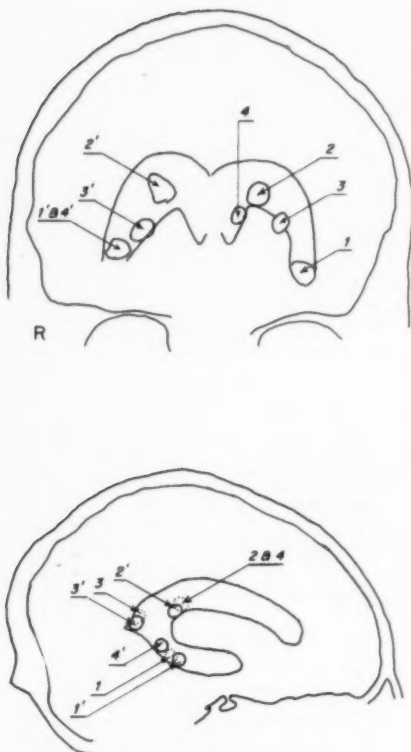
Fig. 5. Composite tracings of pneumoenceph-
alogram in various positions: Upright, *1* and
1'. Brow down from right decubitus (see text),
1' and *2*. Brow down from left decubitus (see
text), *1* and *2'*. Brow up, *3* and *3'*. Right side
down, *4* and *4'*.

ent in our first examination (Fig. 1). On
the other hand, when the right side of the
head was down, the reverse situation
would occur (Figs. 2 and 5—*4* and *4'*).
Once the nature of the asymmetry was de-
termined, one could readily prognosticate
the relationship of the choroids in any
given position. The maximum range of

motion of each is 3.0 cm. in the vertical
plane, 2.5 cm. in the anteroposterior plane,
and 2.0 cm. in the transverse plane.

SUMMARY

A case is reported in which peduncula-
tion of calcified glomi of the choroid plex-
uses of the lateral ventricles permitted
extensive movement depending upon
gravitational effects. This resulted in
variability and marked asymmetry of the
relative positions of the glomi, demon-
strable roentgenographically, in the absence
of a space-occupying intracranial lesion.

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SUMARIO

Plexos Coroideos Calcificados Movibles. Observación

Comuníquese un caso en el cual la pedi-
culación de los glomos calcificados de los
plexos coroideos de los ventrículos late-
rales permitía movimientos extensos basa-
dos en los efectos de la gravedad. Esto dió
por resultado variabilidad y pronunciada
asimetría de las relativas posiciones de los
glomos, demostrables radiográficamente,
en ausencia de una lesión intracraneal que
ocupara espacio.

Ulcer of Greater Curvature of Stomach: Benign or Malignant?

Case Report of a Benign Ulcer[1]

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IN RECENT YEARS it has become fairly well established that peptic ulcer of the greater curvature is a rare condition. The most recent detailed report on the subject is that of Matthews (17), who in 1935 made a thorough review of the world literature. He found only 22 cases described in sufficient detail to warrant the diagnosis. Of these, only 10 cases, including 2 of his own, were proved histologically. Since that time, van Buchem (21) in 1938, Blum (3) in 1944, and Preiss (18) in 1944 have reported single proved cases. Williams (22) in 1941 presented 2 cases with histologic proof, one of which was prepyloric. Campbell (6) in 1948 added 2 cases, but only one of these was confirmed by operation and histologic examination.

Sproull (20) concludes that "it is probably unwise for a roentgenologist to diagnose a lesion on the greater curvature as benign peptic ulcer. The chance of the diagnosis being correct is very small—probably one in a million." He raises doubt as to the accuracy of diagnosis of cases reported in the literature even when confirmed by histologic examination.

Leahy, in the discussion of a paper by Boles (4), writes: "We agree that we have never seen a benign ulcerating lesion on the greater curvature." Golden (10), in a personal communication, made a similar statement.

Holmes and Hampton (14), in 1932, reporting on a series of 128 proved gastric ulcers and an additional 128 found by roentgen examination and presumed to be benign, found none on the greater curvature. They mention, also, that in 202 autopsied cases of gastric ulcer, not one was found on the greater curvature. In addition, they quote Orator, who studied 330 cases from Eiselberg's clinic both grossly and histologically and found no instance of benign greater curvature ulcer. Bowers and Rivers (5), in 1933, reviewing 617 benign ulcer cases, found none on the greater curvature.

A case of benign ulcer of the greater curvature is being reported here. This is the only case with this diagnosis discovered in a review of the records of 475 cases of benign gastric ulcer among patients admitted to the New York Hospital from 1932 until the present date. Several cases with multiple acute ulcers on the greater curvature found incidentally at autopsy are not considered.

CASE REPORT

M. A. B., a 59-year-old white female, was admitted to the hospital Feb. 4, 1946, with a six-month history of nervousness, which became apparent shortly after she learned that her husband had a carcinoma. From that time on she often became nauseated. Four months prior to admission she began having epigastric pain, dull to knife-like in character, irregular in onset and duration. It bore no relation to meals, and food and alkalies gave no relief. The patient stated, however, that pain had become less severe on a milk diet, which she started about six weeks prior to admission. Nausea continued and was associated with the smelling of food, especially meat. Anorexia was present. There was very occasional vomiting without hematemesis. There were no tarry stools. The patient had lost approximately 15 pounds of weight.

The family history was entirely negative with respect to cancer.

Physical Examination: The physical examination was essentially negative. The patient was apprehensive but in no acute distress. She appeared emaciated; loss of weight seemed to be recent. The abdomen was soft and non-tender. Liver and spleen were not palpable, nor could other abdominal masses be felt. There were no palpable lymph nodes.

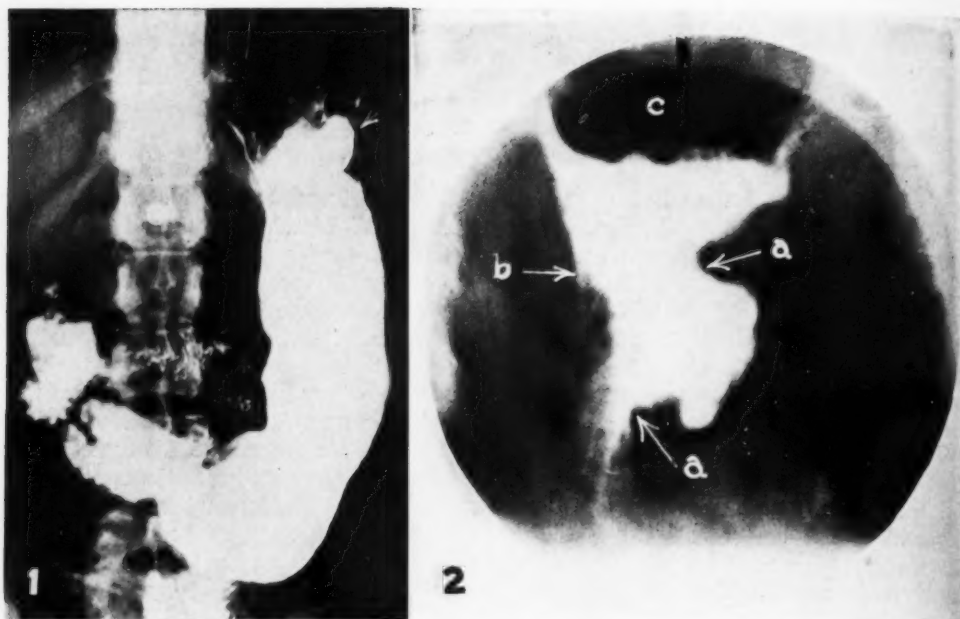*Laboratory Data:* Urinalysis was negative. Hemoglobin was 14.5 gm., erythrocytes 4,000,000,

Fig. 1. Roentgenogram (Jan. 22, 1946) showing large niche on greater curvature at the junction of the fundus
and pars media.
Fig. 2. Spot film (Jan. 22, 1946) showing ulcer crater extending from *a* to *a;* lesser curvature at *b;* fundus at *c.*

leukocytes 6,400, with a normal differential count. Blood chemistry studies were normal; the Mazzini test was negative. Two stool examinations were guaiac-negative. Gastric analysis on an empty stomach revealed 5 units of free acid, 12 units of total acid; thirty minutes after the injection of histamine, 28 units of free acid and 35 units of total acid.

Roentgen Examination: A gallbladder series was negative. A gastro-intestinal series just prior to admission revealed a large niche, measuring approximately 2.5 cm. in diameter, on the greater curvature at the junction of the fundus and pars media. The lesion was regular in contour and projected beyond the normal outline of the lumen. There was no demonstration of a meniscus sign. On fluoroscopic examination the adjacent portions of the stomach wall appeared rigid. The rugae converged toward the lesion. Localized tenderness was present. Peristaltic waves appeared to commence distal to the lesion and were normal. Otherwise the gastro-intestinal study was negative. Radiologic diagnosis was gastric ulcer of the greater curvature with strong possibility of malignancy.

Operative Findings: An exploratory laparotomy was performed under general anesthesia on Feb. 14, 1946. A definite ulcerating lesion was found on the greater curvature at about the junction of the upper and middle thirds. It was indurated on the surface and, to the operator, it was very suspicious of carci-

noma. Numerous small firm lymph nodes were scattered along both the greater and lesser curvatures of the stomach. Two of these were removed for frozen section, and were found to be inflammatory in nature. A sleeve resection was carried out. A segment of the pyloric end of the stomach was left which measured 5 to 6 cm. on the greater curvature side and 4 to 5 cm. on the lesser curvature side. The proximal end of the stomach was divided at a level about 3 cm. above the lesion. The central segment of the stomach was removed, and the proximal and distal segments were anastomosed.

Examination of the resected portion of the stomach, to the surprise of the operator, showed the lesion to have all the gross manifestations of a benign ulcer.

Pathologic Findings: The removed portion of the stomach, when spread out, measured approximately 12 cm. on all sides. Along the attachment of the greater omentum, marking the greater curvature of the stomach, at a point 3 cm. from the cardiac end, was a large ovoid ulcer measuring 3 cm. in length, 1.5 cm. in width, and 0.5 cm. in depth. On cutting through the ulcer it was found to be very hard. The edges were undermined, but there was none of the obvious signs of carcinoma that one would expect in the crater. It seemed to be filled with a paper-like membrane. Scattered along the attachment of the greater omentum, as well as the under peritoneal surface of the stomach, were numerous lymph nodes

2 or 3 mm. in diameter, which were very hard and white.

Histologic Examination: Examination of microscopic sections of the ulcer showed widespread scarring and inflammation. There was overgrowth of the epithelium at the margin of the crater but it was
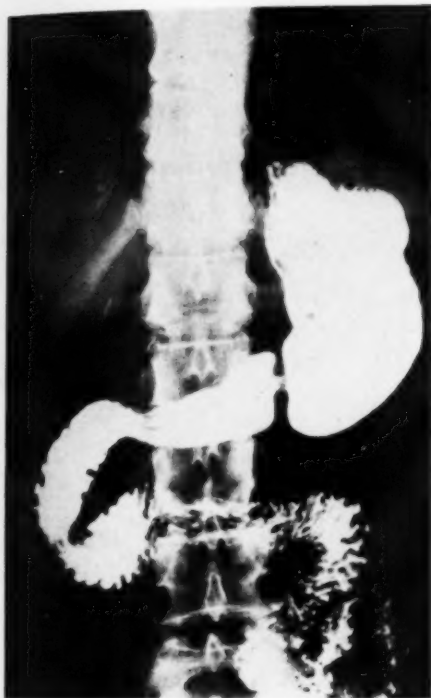

Fig. 3. Postoperative roentgenogram (April 1, 1946), showing result of sleeve resection.

not metaplastic and showed no evidence of carcinomatous change. There was a very lively acute inflammation of the bed of the ulcer, which was covered with slough. The lymph nodes showed chronic inflammation.

The pathologic diagnosis was long standing chronic gastric ulcer of the greater curvature (Dr. N. C. Foot, Surgical Pathologist to the New York Hospital). The non-malignant nature of the lesion was verified by another pathologist (Dr. Fred Stewart of Memorial Hospital).

Subsequent Course: The patient made an uneventful recovery from the operation and was discharged from the hospital Feb. 27, 1946. Gastrointestinal series on four occasions, the last on May 7, 1948, have shown a well functioning stomach with no evidence of a recurrent lesion. When last seen, twenty-seven months after operation, the patient continued to be free of symptoms and was maintaining her postoperative weight gain of 10 pounds.
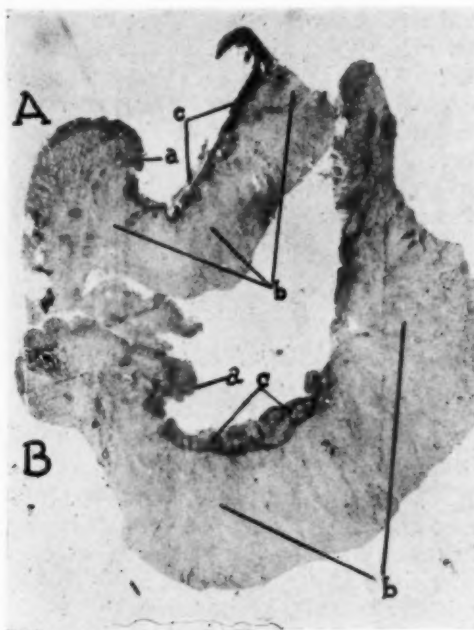

Fig. 4. Photomicrograph ($\times$ 10) of two sections of the ulcer, A and B, showing overgrowth of epithelium at the margin (a), scar tissue (b), and overlying slough (c).

DISCUSSION

The case under consideration presented features which favored both a benign and a malignant lesion. The age of the patient, the weight loss, the short duration of symptoms, the location of the ulcer, the size of the crater, the relatively low free hydrochloric acid, and certain clinical symptoms suggested a malignant neoplasm. The protruding regular niche with a negative meniscus sign, the convergence of rugae toward the crater, the localized tenderness, and the absence of occult blood favored a benign ulcer.

Cancer tends to occur in an older age group than ulcer, the average age at onset of symptoms being fifty-five and forty years, respectively. Alvarez and MacCarty (1), however, in a large series of cases, found an insignificant difference in the ratio of ulcer to cancer in patients of thirty to sixty years.

A significant weight loss is uncommon in benign ulcer and bespeaks malignancy.

Jordan (15), however, found a severe weight loss in 14 of her series of 119 cases of gastric ulcer.

A long history of ulcer symptoms is regarded as suggesting a benign lesion, and a short history—12 months or less—as favoring malignancy, but in her series of 119 ulcers Jordan had 22 cases with a history of less than a year duration.

The location of a gastric ulcer on the greater curvature greatly favors malignancy.

The larger the diameter of an ulcer, the greater is the chance of its being malignant. MacCarty (16), in the Carman Lecture of 1940, claimed that at least 90 per cent of all chronic gastric ulcers larger than a quarter (2.5 cm. in diameter) are definitely cancers. Eusterman (8) stated that any lesion larger than this size is to be considered malignant until proved otherwise.

Holman (11), using the histamine method of Bloomfield and Polland (2), personally performed several hundred gastric analyses. He never found a low acidity or anacidity in a patient with a benign lesion; a normal or higher than normal acidity, on the other hand, was found in only about 15 per cent of patients with a proved carcinoma. Holman concluded that gastric analysis was the most accurate single method of differential diagnosis between benign and malignant ulcer. In a personal communication, Holman (12) expressed his opinion that the low value of free acid in the reported case, might well be explained on the basis of improper technic. His experience (13) on numerous occasions has been that the results obtained by a relatively uninterested technician or nurse will not compare with the results of one who is responsible for, and interested in, the correct diagnosis.

In gastric ulcer, one usually expects a rather typical symptomatology—daily occurring pain-food-ease sequence and a normal appetite. In carcinoma the gastric discomfort is more often steady, aggravated rather than relieved by food, and accompanied by early-appearing nausea and vomiting. Exceptions to the general rule are, however, prone to occur. Eusterman and Balfour (9) stated that about a fourth of all resectable carcinomas temporarily simulate ulcer, especially at the onset, and more than half of all resectable carcinomatous ulcers and carcinomas-on-ulcers give rise to the same symptoms as ulcers, but over a briefer period. Jordan (15), in discussing the gastric ulcer problem, based upon her series of 119 cases, stated that certain data are of no value in deciding the question of benignity and malignancy, namely: (a) length of history and recent change in symptoms, (b) absence of food relief, (c) frequency of vomiting, and loss of appetite and weight, without obstruction.

An ulcer crater, smooth in outline, projecting beyond the normal outline of the lumen, with uninterrupted rugae converging toward it, favors benignancy. It must be borne in mind, however, as stressed by Eusterman (8), that the crater of a carcinomatous ulcer may appear as a niche projecting beyond the luminal outline. A positive meniscus sign—that is, a crater within the lumen with a clear zone around it representing tumefaction—usually indicates malignancy. Other common findings in the presence of a malignant lesion are a crater irregular in outline, abrupt interruption of rugal markings, and an appearance of rigidity and loss of flexibility in the adjacent area. Localized tenderness and spasm favor a benign lesion.

Occult blood is more significant of carcinoma, whereas extensive hemorrhage with melena is more commonly associated with benign ulcer. Cutler and Buschke (7) have made the statement that in the presence of clinical symptoms, the regular absence of occult blood almost always allows one to exclude a carcinoma, with the exception of the scirrhous forms. Bleeding due to a malignant neoplasm is usually continuous and not affected by a trial medical regime. A progressive secondary anemia in older individuals should direct one's attention toward gastric carcinoma. A primary macrocytic anemia may accompany cancer.

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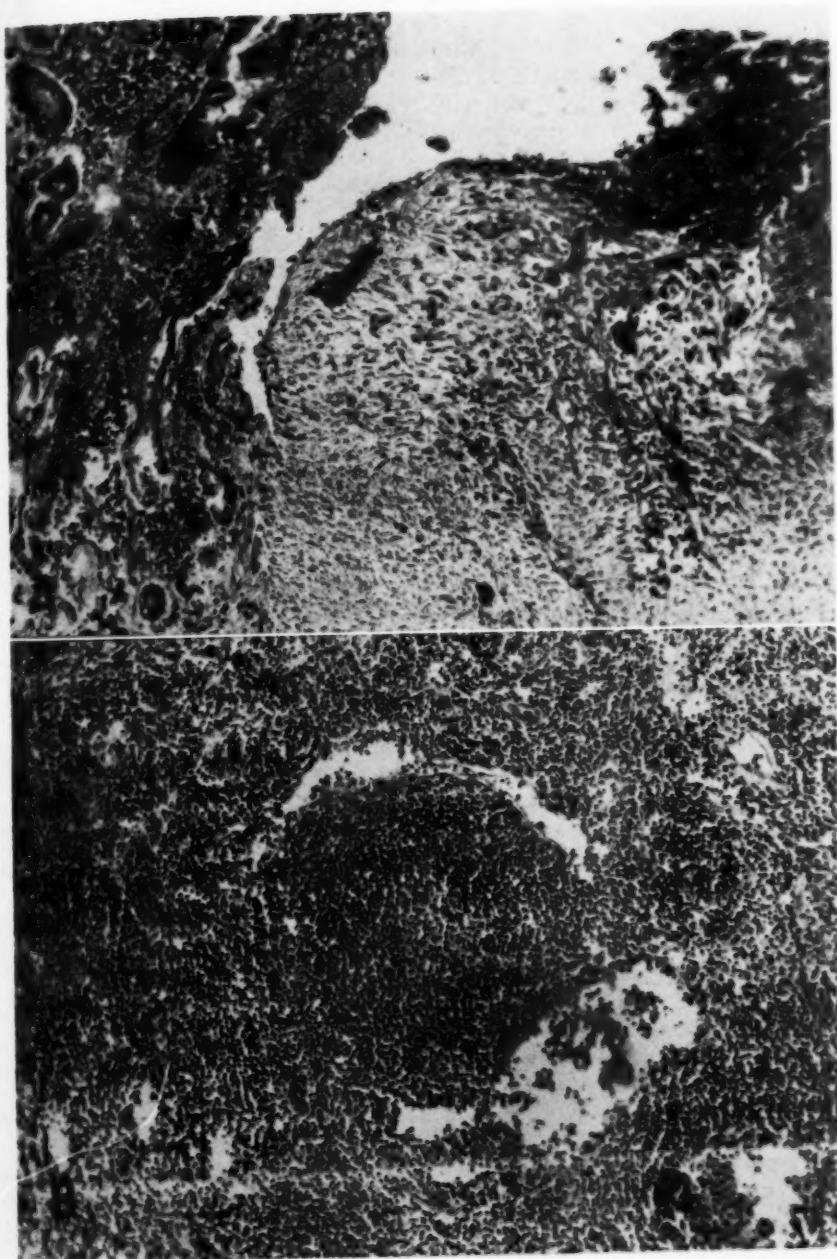 a trial
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Fig. 5. A. Photomicrograph ($\times$ 125) showing transition from glandular mucosa to the area of erosion. There is acute inflammation of the bed of the ulcer. No evidence of malignant change.
  B. Photomicrograph ($\times$ 125) of gastric lymph node. No evidence of malignant change.

mentioned diagnostic features in differentiating between benign and malignant lesions in any individual case, the writer concurs with Rivers and Dry (19), who state that it is obviously impossible to distinguish positively between malignant and benign lesions without a careful microscopic investigation.

Sproull (20), in 1931, presented a case of ulcer of the greater curvature, characteristic of a benign lesion in all respects, with response to a medical regime and an apparent cure, except for failure of the lesion to disappear as viewed roentgenographically. At operation, thirteen months after the onset of symptoms, a benign appearing crater was locally excised. On macroscopic examination, the pathologist concurred in the surgeon's opinion that the lesion was benign. Microscopically, however, it was proved malignant, and the patient died two years later of a large inoperable carcinoma. On the basis of this experience, Sproull laid down stringent rules which he felt should be observed in reporting any lesion of the greater curvature as benign: (a) histologic examination of the specimen by more than one pathologist, (b) incorporation in the report of the clinical history, operative findings, roentgen findings, a photograph or drawing of the lesion, and a detailed histologic examination with the accompanying photomicrographs.

SUMMARY

Benign ulcer of the greater curvature is a rare condition. Only a few cases with histologic proof have been recorded in the literature. An additional case is reported. Preoperatively, most of the diagnostic criteria favored malignancy, but a benign lesion was found at operation and was proved histologically. The patient is asymptomatic twenty-seven months after operation, at which time a gastro-intestinal series shows no evidence of recurrence of the ulcer. A review of the criteria for differentiation between benign and malignant lesions, based upon the findings in this case, is presented. The conclusion is reached that it is not possible to make a positive distinction between benign and malignant ulcers without a careful histologic examination.

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SUMARIO

Ulcera de la Curvatura Mayor del Estómago: ¿Benigna o Maligna?

La úlcera benigna de la curvatura mayor es rara. En la literatura aparecen unos pocos casos con comprobación histológica. Comunícase ahora otro más. Preoperatoriamente, la mayor parte de las pautas de diagnóstico favorecían la malignidad, pero al operar se descubrió una lesión benigna, comprobándolo el examen histológico. El enfermo se encuentra asintomático a los 27 meses de la intervención, y una serie de radiografías gastrointestinales no revela signos de recurrencia. Basada en los hallazgos en este caso, ofrécese una reseña de las pautas de diferenciación entre las lesiones benignas y las malignas, llegándose a la conclusión de que no es posible diferenciarlas sin un cuidadoso examen histológico.

The Use of Adrenal Cortical Hormone in Radiation Sickness[1]

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RADIATION sickness has up to now been considered exclusively as a complication in radiation therapy. Recently this syndrome has attracted more general interest as an important effect of exposure to radiations generated during nuclear fission (atom splitting) (1). The problem of treating radiation sickness has consequently become one of great timeliness and importance. Advances in the study of clinical signs and symptoms of this condition and their etiology have opened new avenues of approach for its treatment.

In the light of present-day knowledge, radiation sickness represents a symptom complex involving numerous systems of the body. The symptoms may be grouped as follows (2):

General Symptoms
Headaches, dizziness, weakness, and occasionally fever
Gastro-intestinal Symptoms
Anorexia, nausea, vomiting, diarrhea, and tenesmus
Cardiovascular Symptoms
Tachycardia, arrhythmia, and fall in blood pressure
Hematological Symptoms
Leukopenia, thrombopenia, and increased sedimentation rate
Psychic Symptoms
Irritability, insomnia, and fear

The symptomatology of radiation sickness points to adrenal cortical insufficiency. Further signs in this direction can be found in a study of the metabolic changes occurring in the irradiated body (3). Most prominent among these are the loss of chlorides, disturbance of the water metabolism, decrease of blood cholesterol levels with increased fat deposits in the liver (4), and a biphasic response of the blood sugar and of the hydrogen-ion concentration in blood and tissues. Radiation sickness thus represents a typical case of the "adaptation syndrome" of Selye (5), *i.e.*, the unspecific response of the body to stress, irrespective of its causation by chemicals, bacterial toxins, or physical agents. The course of the adaptation syndrome is largely determined by adrenal cortical activity. This modern concept of radiation sickness agrees perfectly with the long-accepted view of the etiology of radiation sickness as a general intoxication due to tissue decomposition products (3).

Research work of recent years has considerably clarified the nature of these toxic substances. In the light of these investigations the toxic agent might best be described as histamine-like in nature, if not histamine itself, for the following reasons:

(*a*) Histamine is capable of producing most of the symptoms of radiation sickness, including those of salt/water metabolism and cholesterol metabolic changes (6), which are prominent in radiation sickness (8).

(*b*) Histamine is also capable of producing fatty changes in the liver (33), as characteristic of the adaptation syndrome (5) and as seen in various animal species following irradiation (4). The accumulated evidence indicates that these fatty changes in the livers of irradiated animals are largely produced indirectly as the result of tissue decomposition products (4). It has furthermore been demonstrated that fatty infiltration of the liver does not occur in adrenalectomized animals (7). This phenomenon is thus linked on the one hand

to the production of the toxic substances resulting from radiation-induced tissue destruction and, on the other hand, to adrenal-cortical activity.

(c) Histamine is present in most organs of the mammalian body (6). Its liberation from these tissues following irradiation is easily understood. Besides, new formation of histamine from the amino-acid histidine, a protein component, has been demonstrated by us by irradiation with cathode rays (31). Inasmuch as the secondary cathode rays are the biologically effective rays in x-ray irradiation, this process may account for certain phases of the intoxication process.

(d) There is ample evidence available indicating the circulation of histamine-like substances in the irradiated body (9–14). Segal (15) demonstrated increased blood histamine levels in patients following x-ray treatment.

Our knowledge of the etiology of radiation sickness has also been greatly enlarged by studies concerning the regulation of lymphatic tissue activity by the pituitary-adrenal cortical mechanism (16, 17). Of particular interest are the observations by Dougherty and White (18) that leukopenia following x-ray irradiation is at least in part due to the indirect action of tissue decomposition products. In mice receiving a dose of 10 r in total body irradiation, a leukopenic response was observed. This dose also increased the secretion of pituitary-adrenal cortical hormone. Since irradiation of adrenalectomized animals failed to produce leukopenia, it appears that this is an indirect radiation effect mediated *via* the pituitary-adrenal cortical mechanism. Larger doses (200 r), however, produced a leukopenia in adrenalectomized animals also. In this instance the irradiation affects the lymphatic tissues directly.

Irradiation over the adrenals produces marked cortical changes (Engelstad and Torgersen, 19) and leads to depletion of sudanophile substances in the cortex (20). Depletion of sudanophile substances is considered as an indication of increased activity of the gland (5, 21, 22, 23). Torgersen (20) was able to show that isolated irradiation of a rabbit's ear produced changes in the sudanophile fat content similar to those resulting from direct exposure, thus demonstrating the role of tissue decomposition products in producing this radiation effect. Patt and his collaborators (24) found changes in the weight of the adrenals in mice corresponding to the loss in adrenal cortical cholesterol content, following total body irradiation with doses corresponding to L.D. 50 and L.D. 100.

In summarizing, we may state that in the light of present-day knowledge, the mechanism of radiation sickness appears as follows: irradiation of a sufficiently large volume of the body results in the release, or photochemical production, of histamine-like substances, if not of histamine itself. These substances cause the anterior pituitary to secrete corticotrophic hormone, which in turn stimulates adrenal-cortical activity. This stimulation may well result in exhaustion of the gland.

Among the highly varied list of suggestions for the treatment of radiation sickness, the use of desoxycorticosterone acetate (DCA) a synthetic hormone of the adrenal cortex, appears to be of particular interest (25). This hormone is known to counteract the mineral losses caused by adrenal-cortical insufficiency (26) and is also known to play an important role in the inactivation of histamine (26). In the light of our present knowledge of the mechanism of radiation sickness, the use of DCA in the treatment of this distressing complication of radiation therapy appears to be logical. In recent studies, with mice as test objects, we have been able to present evidence of a sound experimental basis for the clinical use of this preparation. It was demonstrated that DCA protects the liver against radiation-induced fatty changes (27) and that this liver-protecting action is accompanied by a decrease in the mortality rates produced by various doses of x-rays applied in total body irradiation (28). It was demonstrated, furthermore, that both

effects are dependent on the size of the daily dose of DCA (29); 0.5 mg. was found to be an optimal dose for daily administration. The effect on the mortality rate is shown in Figure 1. It may be noticed that the lethal effect of L.D. 50 was reduced by almost 50 per cent.

mediately after death, and the organs were fixed in Zenker's solution, embedded in paraffin, sectioned at 4μ, and stained with hematoxylin-eosin. The adrenals were fixed in 10 per cent formalin and sections were made with the freezing microtome and stained with sudan III. The fol-
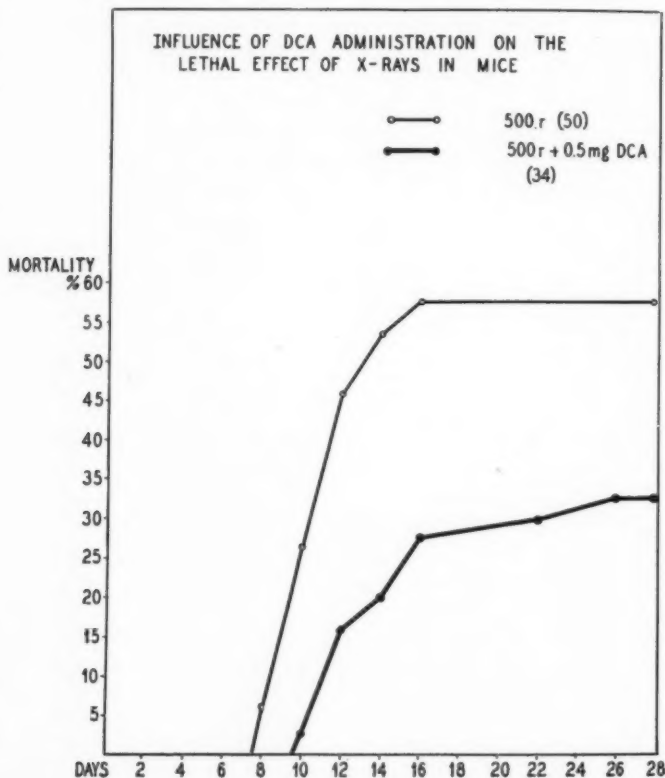

Fig. 1. Effect of administration of desoxycorticosterone acetate (DCA) in reducing the mortality among irradiated mice.

We have extended our studies of the influence of DCA on the effects of x-rays to include the effects on the spleen, bone marrow, and adrenal cortex. The observations are based on a group of 100 male Swiss white mice (average weight 25 gm.). The animals were exposed as previously described (30), to 500 r/air of x-rays (h.v.l. 0.75 mm. Cu), given as total body irradiation, in one exposure. They were then killed at different intervals following irradiation. Autopsies were performed im-

lowing arbitrary grades were selected for quantitative evaluation of tissue changes:

Spleen

+ Malpighian bodies indistinctly outlined
++ Large remnants of malpighian bodies
+++ Small remnants of malpighian bodies
++++ No malpighian bodies, or traces only

Bone marrow

+ Slight decrease in white cells
++ Definite decrease in white cells
+++ Severe decrease in white cells, with considerable increase in red cells
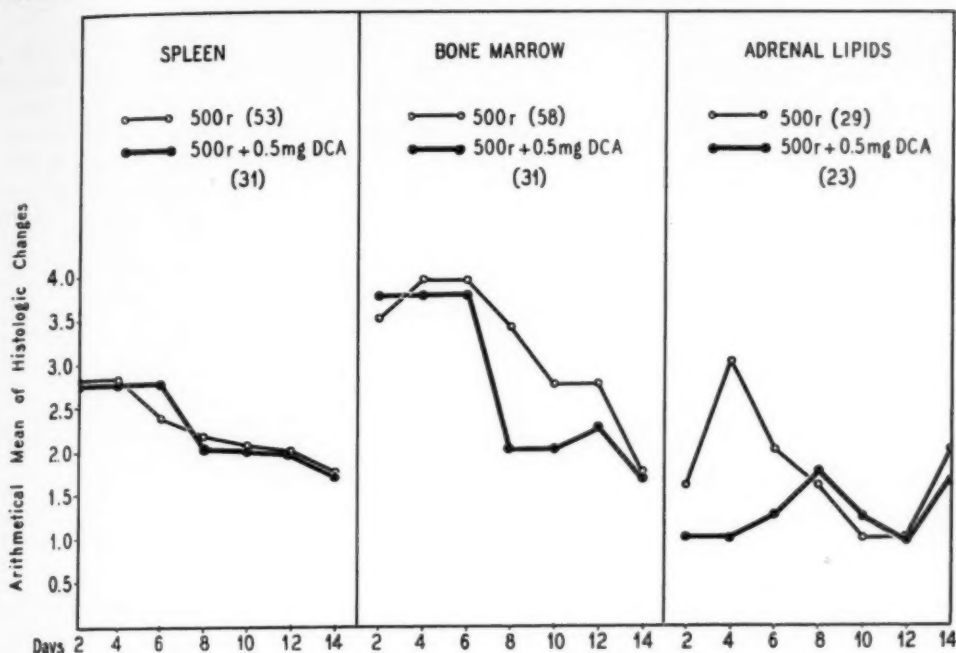++++ White cells depleted or almost depleted

Fig. 2. Effects of desoxycorticosterone acetate (DCA) on x-ray induced changes in the spleen, bone marrow, and adrenal cortex in mice.

Adrenal cortex

+ Decrease in fat, as occasionally seen normally
++ Definite decrease in fat
+++ Only traces of fat
++++ No fat

The results of the study of the spleen, bone marrow, and adrenal cortex in animals which were irradiated and those which were irradiated and treated daily with 0.5 mg. DCA are presented in Figure 2. The ordinate values indicate the arithmetical means of the changes observed in the individual animals killed each day. The abscissa values represent the days after exposure to the x-ray dose of 500 r. The numerals in parentheses indicate the total number of animals studied.

As may be noticed, there was no change observable in the x-ray-induced effects in the spleen. In the bone marrow, however, a definite and statistically relevant change is noticeable in the DCA-treated group. Similarly a decreased depletion of sudanophile fat of the adrenal cortex was ob-

served in the animals receiving DCA. That the effect in the adrenals appears only in the first week following irradiation seems to be explainable by the fact that in the further course the cortical fat content returned to normal, and our method did not permit a quantitative assay of increased amounts of fat beyond the already large amounts present in normal cortical tissues. Whether the failure to observe changes in the spleen similar to those observed in bone marrow is also due to the method of study or is a factual one cannot be decided at this point.

The additional data concerning the influence of DCA administration on the organ changes produced by irradiation are in accord with the known facts as to the action of the adrenal cortex. They represent an interesting rounding out of our investigations. It appears that the administration of DCA prevents the exhaustion of the adrenal cortex caused by irradiation. As explained by Long (32): "If the fall in the blood level of cortical hormone is prevented

by injection of exogenous cortical hormone, then pituitary does not respond. In other words, a differential and temporary hypophysectomy is achieved by this means."

In the light of these data, it appears that *the use of DCA represents a treatment of radiation sickness which strikes at the etiology of this symptom complex.*

A clinical study of the usefulness of DCA in the treatment of radiation sickness has been carried out under the supervision of the writer at the Veterans Hospital, Bronx, N. Y., in co-operation with Drs. B. Roswit and S. M. Glasser. Out of a series of 50 patients, all of whom exhibited nausea and/or vomiting, 37 were completely relieved of these distressing symptoms. The details of this preliminary clinical study will be reported elsewhere. The conclusions drawn from animal experiments as to the usefulness of DCA in the treatment of radiation sickness have thus been confirmed by clinical experience. These conclusions were based chiefly on the protective action of DCA against radiation-induced fatty changes in the liver. It appears logical, therefore, to assume that the other important action of DCA, namely the reduction of the mortality produced by x-rays in mice, may also apply to human beings whose entire bodies are accidentally exposed to lethal doses of ionizing radiations.

SUMMARY

(1) Recent advances in the understanding of the symptoms and etiology of radiation sickness are reviewed.

(2) In the light of these studies, radiation sickness appears to be due to adrenal-cortical insufficiency. The use of adrenal-cortical hormone for the treatment of radiation sickness therefore appears logical.

(3) Experimental data are presented which furnish a sound basis for the application of desoxycorticosterone acetate (DCA), a synthetic hormone of the adrenal cortex, in the treatment of this condition.

(4) It is believed that DCA may prove of value not only in the treatment of radiation sickness encountered as a complication of radiation therapy, but also in radiation sickness occurring as the result of accidental exposure to lethal doses of ionizing radiations.

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SUMARIO

Empleo de la Hormona Córticosuprarrenal en la Enfermedad de Irradiación

A la luz de recientes estudios, la enfermedad de irradiación parece debida a insuficiencia córticosuprarrenal. Parece, pues, lógico emplear la hormona córticosuprarrenal en el tratamiento de la misma, y en apoyo de esta teoría preséntanse experimentos en animales. Ya se había demostrado que la desoxicorticosterona, hormona sintética de la corteza suprarrenal, protegía los hígados de los ratones irradiados contra las alteraciones adiposas provocadas por la radiación y obtenía una disminución bien definida en la mortalidad. Esos estudios han sido ahora extendidos al influjo de la hormona sobre la patología del bazo, médula ósea y corteza suprarrenal. Las alteraciones irradiatorias en el bazo no fueron afectadas por la hormona. Sin embargo, hubo alteraciones bien definidas en la médula ósea y en la corteza suprarrenal se observó reducción de la grasa sudanófila. Parece, pues, que la administración de desoxicorticosterona impide el agotamiento de la corteza suprarrenal que producen los rayos X.

Opínase que la desoxicorticosterona puede resultar útil en el tratamiento, no sólo de la enfermedad de irradiación observada como complicación de la radioterapia, sino también en la que sobreviene tras la exposición fortuita a dosis letales de radiaciones yonizantes.

Effects of Radiation on Hemopoiesis[1]

JOHN S. LAWRENCE, M.D., ANDREW H. DOWDY, M.D., and WILLIAM N. VALENTINE, M.D.

A CONSIDERATION of the effects of radiation on the hemopoietic tissues brings one into a controversial field. This is necessarily so, since various modes of subjecting the blood and the hemopoietic tissues to radiation have been used. Further, results in one species do not always agree with those in other species and hence confusion is frequently caused by an attempt to apply to one species what has been found to occur in another. Difficulties of the above type are so commonly encountered in the older literature on the subject that it has been decided not to include here any survey of this literature. Excellent reviews are available for those who want them. One of the most recent is that by Shields Warren in 1942.

The types of radiant energy under consideration in this discussion are either electromagnetic energy waves, such as roentgen and gamma rays, or particulate matter having mass, such as alpha and beta particles, protons, and neutrons. While the former are devoid of mass (other than energy mass) and electrical charge, they may for convenience be considered as bullets of energy called quanta. The alpha particle is the nucleus of the helium atom, having a unit positive charge of two and a unit mass of four. The beta particle (electron) has a negative charge of one and a unit mass of 1/1840. The proton is a component of all atomic nuclei and comprises the entire mass of the hydrogen nucleus. It has a unit positive charge of one and unit mass of one. The neutron is a component of all atomic nuclei with the exception of the hydrogen nucleus. It is neutral in charge and has a unit mass of one. The positron and mesotron are omitted from this discussion for simplification.

An unstable atomic nucleus (one having excess energy) may return to a more stable state by the release of energy in the form of an alpha particle, an electron, a proton, a neutron (neutron only during fission process), a gamma ray, or by a combination of several of these forms of energy. An unstable atom may release its excess energy in the form of light, heat, or roentgen rays, or by a combination of two or more of these forms.

Materials being subjected to these radiations may be considered as being bombarded with quantas of energy without mass and by particulate matter having both mass and energy. All living cells, whether of man, animal, or plant, are capable of injury from these various types of radiant energy. The extent, location, and type of injury which may be sustained are dependent upon the kind of radiation under consideration, its physical properties, its mode of application, (whether external or internal), its intensity, duration of exposure, and the character and function of the cells of the species of animal or plant being subjected to irradiation. In other words, the degree and character of the biological changes resulting from irradiation are dependent upon many complicating factors and often subject to difficulties of interpretation.

The data herein reported represent the opinions of the authors *at the present moment*. They are not static and will require changing from time to time as more information becomes available. Much of the background for these opinions is to be found in the work done by various members of the Manhattan Project. It has been our privilege to see many of the reports of this group which have not been cleared for public presentation. The investigators, in addition to those in this laboratory, whose work has been used in one way or another in this report are Allen and associates,

Bryan and associates, Failla and associates, Henshaw and associates, Metcalf and associates, Rekers and associates, and Suter and associates. Their work will be published in scientific journals in due time. We wish to express our sincere thanks to them for their willingness to allow us to use their data.

Much confusion will be avoided in considering radiation effects on hemopoiesis if the following facts are recognized:

First, there is virtually no evidence supporting the concept that the morphological constituents of the peripheral blood are affected directly by radiation except in tremendous amounts. In other words, the cells in the blood are for all intents and purposes relatively resistant to radiation.

Second, the peripheral blood picture produced by radiation is affected markedly at any one period following irradiation by the length of life of the different morphological elements in the peripheral blood. (The life span of the red blood cell has been established in man and dog. The life spans of the white blood cells and the platelets have been determined in the cat in this laboratory, but no satisfactory observations have been made on human beings.) Thus, since it takes only ten to twelve hours at the most for complete turnover of all of the white cells in the blood at any one time, changes in the white cell picture should occur within a short interval following irradiation. The blood platelets in the peripheral blood of the cat require complete replacement every four to five days. Hence, changes in their number in the peripheral blood would not be expected until later than in the number of the white blood cells. Finally, the life of the red blood cell in man and the dog is pretty generally accepted as being approximately one hundred and twenty days. One would not, therefore, expect reduction in the number of the red blood cells to become apparent until later than in the white cells and the platelets. Alterations in the numbers of erythrocytes would be often masked by regeneration, since the latter frequently occurs well within the life span of this ele-

ment. To take a concrete example, suppose sufficient parent erythroid cells are destroyed at any one moment by irradiation to reduce the manufacture of red blood cells by one-tenth. If we consider that approximately 1.0 per cent of the red blood cells in the body are manufactured daily, then, in this situation, we would have 0.9 per cent manufactured daily; that is, instead of an output sufficient to replace the 50,000 red cells per cubic millimeter of peripheral blood destroyed daily by the normal male, we could only replace 45,000 per cubic millimeter. This rate of manufacture would have to continue for sixty days before a deficit of 300,000 cells per cubic millimeter would develop. Any change of less than this amount would be unlikely to be detected in a normal individual due to the errors inherent in technic and the physiological variations. By the end of sixty days, considerable regeneration would be expected to have taken place, and this would most probably result in complete masking of any effect of radiation on the erythroid cells.

Third, the effect of radiation on the peripheral blood picture is influenced by the radiosensitivity of the various parent cells. There is ample reason for considering that the parent cells of the lymphocytes are more radiosensitive than the parent cells of the other cellular elements of the blood. Thus, the total number of lymphocytes diminishes more rapidly following irradiation than that of any of the other blood cells. Further, an effect of irradiation on the lymphocytes can be demonstrated with smaller amounts of radiation than is true for the other cells. Additional discussion of these facts will be taken up later.

Fourth, the ability of the tissue to regenerate is of great importance. Not too much is known of this, but there is substantial evidence that this ability is very good in the lymphatic tissue. However, there is strong evidence that the erythroid, myeloid, and megakaryocytic tissues are also capable of very active regeneration. Insufficient studies have been

made to allow any statement as to the variations, if any, in the regeneration ability of these various tissues.

The most important consideration from the point of view of the time when changes are to be expected in the peripheral blood from irradiation is the length of life of the various cellular elements. Actually, we shall see that the order of time when these changes do occur in the blood is the same as their rate of utilization or life span in the blood. In other words, the white blood cells show changes first. These are followed by changes in the platelets and, later, in the red blood cells. It might be mentioned here that the lymphocytes are the first of the white cells to be reduced. This is considered to be due to the greater radiosensitivity of their parent cells and, *possibly*, to the fact that there are fewer stages between the parent and the adult lymphocyte than is true for the other cells. Due to this, the marrow may contain appreciably more cells sufficiently differentiated to escape radiation injury than does lymphoid tissue. These cells might be expected to complete their maturation and, until exhausted, to replenish the peripheral blood. In other words, the storage of potential granulocytes, red blood cells, and platelets may be greater than that of lymphocytes. The above statements are, of course, based on the assumption that irradiation affects the parent cells, that is, it stops manufacture of cells in their early stages. There is much evidence to justify this assumption.

In this discussion we shall consider the effects of radiation when administered as:

1. Single dose to the body as a whole.
2. Repeated small doses to the body as a whole.
3. Single or repeated doses to one area.
4. Internal radiation (probably beta and gamma mostly).

SINGLE DOSE OF ROENTGEN RADIATION TO THE BODY AS A WHOLE

Most of the worth-while observations on the effects of roentgen radiation applied generally in a single dose have been made in animals. To what extent these observations apply in man cannot be stated. Various species (monkeys, rabbits, dogs, cats, and many others) have been used. In one study (Bryan, Suter *et al.*) a large series of rats was used. These were divided into groups receiving different amounts of irradiation in a single dose: 25 r, 50 r, 100 r, 200 r, 300 r, 400 r, 500 r, 600 r, 700 r, 800 r, 1,000 r, 1,250 r, and 1,500 r. The blood findings in these animals were followed closely for twenty-five days, counts being made at twenty-four hours after exposure and, following that, at forty-eight-hour intervals until the eleventh day. Additional counts were made on the eighteenth and twenty-fifth days post-irradiation. In another study (Metcalf and associates), a large series of rats was given 550 r to the whole body in a single dose. Blood studies were made fifteen minutes after exposure and thereafter at frequent intervals up to forty-one days. To avoid hematologic alterations occasioned by the bleeding procedure itself, no one animal was bled more than a few times. The results of these experiments may be briefly summarized as follows:

(1) *Erythrocytes and Hemoglobin:* Little or no detectable alteration of the red blood cells was found in any of the groups receiving 200 r or less. In the group receiving 300 to 500 r, slight questionable changes occurred during the first 168 hours after irradiation. However, there was a substantial reduction in both erythrocyte and hemoglobin levels in these groups between 168 and 448 hours. In the groups receiving 600 r and above, the survival time was not long enough for satisfactory observations to be made, but in the 600 to 800 r groups, significant drops in both the erythrocytes and hemoglobin were present at 168 hours. After this, rapid declines occurred in erythrocyte and hemoglobin levels.

This period of rapid decline in the red blood cell and the hemoglobin levels demands some consideration. It is of distinct interest that it does not occur in rats
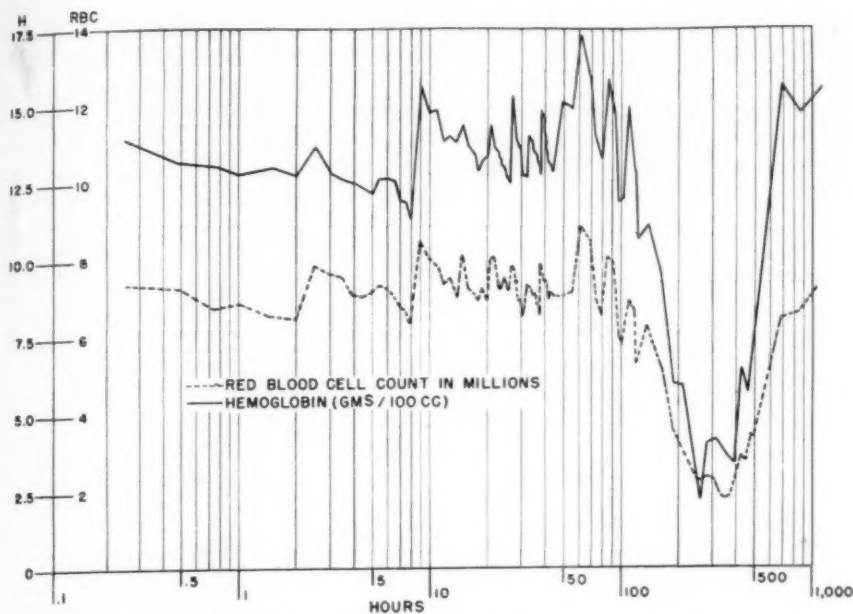
Fig. 1. Mean changes in red blood cell count and hemoglobin of rats receiving 550 r whole body irradiation. (Data of Metcalf and associates.)

receiving less than 500 r. It is depicted very clearly in Figure 1, which is taken from work reported by Metcalf and associates. In this experiment, a large series of rats was given a single dose of 550 r to the whole body. Studies of the peripheral blood and various tissues of the animals were made at frequent intervals for forty-one days after exposure. There was a precipitous drop in the red blood cell and the hemoglobin levels comparable to that seen at the same time interval by Bryan and Suter *et al.* in groups of rats receiving 600 r and above. Metcalf and associates did not feel that abnormal bleeding could explain this rapidly developing anemia, since they noted insufficient evidence to substantiate marked loss of blood. They raised the question of the possibility of some alteration in the circulating erythrocytes since they found active phagocytosis of the latter by the reticulo-endothelial cells. There are, however, so many confusing factors in this reaction, such as lack of knowledge of the life span of the red blood cell in the rat, the possibility of dietary deficiencies sec-

ondary to anorexia, the ulceration and sloughing of the intestinal epithelium, the possible internal bleeding, and some unknown alteration in the red blood cell itself, that we prefer to offer no explanation for this anemia. We do feel that it probably cannot entirely be explained by the effect of radiation on the erythroid tissue with consequent failure to manufacture red blood cells, since it occurs at too early a period after irradiation. It is obviously a response that is associated with radiation dosages of L.D. 50 or above and is not, therefore, of great clinical importance.

(2) *Reticulocytes:* Analysis of the data dealing with the reticulocytes has shown that no reductions of practical magnitude could be detected when doses of 100 r or less were used. With dosages of 200 to 500 r, well marked reductions occurred beginning at seventy-two hours. These persisted up to 120 hours in the 200 r group and up to approximately 280 hours in the 500 r group. In groups receiving 600 to 800 r, regeneration of reticulocytes became apparent at 168 to 280 hours depending on

the dosage. With still higher dosage, the animals died before regeneration could occur. At seventy-two hours after irradiation (the interval at which well marked reductions in reticulocytes were first apparent), successive increments of radiation dosage produced, in general, successive reduction in reticulocytes up to the dosage of approximately 500 r. Increase in the amount of radiation beyond this point produced no further reduction. The assumption can thus be made that up to this dosage some erythrocyte precursors capable of differentiating into reticulocytes were still present, while beyond it virtually none existed.

stantial platelet reduction occurred) showed that increasing dosage of radiation resulted in increasing reduction in platelets up to roughly the neighborhood of 400 to 500 r. No further substantial reduction in platelets occurred following dosages of 600 to 1,000 r.
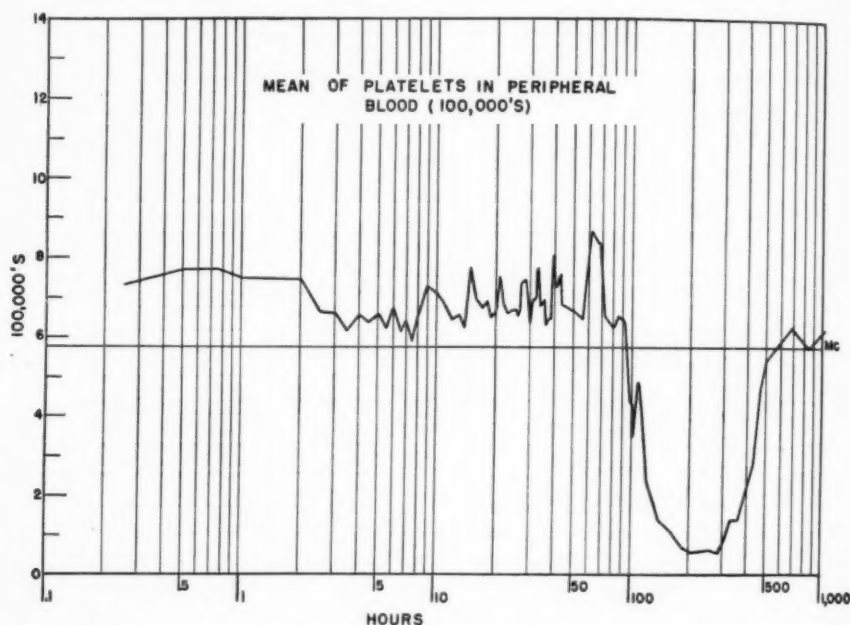

Fig. 2. Mean changes in blood platelets of rats receiving 550 r whole body irradiation. (Data of Metcalf and associates.)

(3) *Platelets:* No significant changes in the platelets were detectable in animals receiving less than 200 r. With dosages of 300 to 500 r, definite platelet reduction was detectable after 120 to 168 hours. Dosages of 500 to 800 r resulted in platelet reduction uniformly by the fifth day. Analysis of the data obtained 120 hours after irradiation (the first point at which sub-

Figure 2 shows the changes in platelets in rats receiving 550 r (Metcalf and associates). The statement can thus be made that platelet production at 120 hours was not maximally decreased until 400 to 500 r or more were given the animals.

(4) *White Blood Cells:* It should be noted that since 70 to 90 per cent of the leukocytes in the normal rat are lymphocytes, any changes in the white blood cell picture of these animals will reflect more the effect on lymphocytes than on granulocytes.

(a) *Neutrophils:* No unquestionable changes occurred in the neutrophils until dosages greater than 100 r were used. There was a transient early neutrophilic leukocytosis in the rats receiving 550 r in

the series studied by Metcalf and associates. The first period at which unquestionable reduction in the total number of the neutrophils below the pre-irradiation level occurred was twenty-four to thirty-six hours after exposure. Following this, there was a steady decline up to approxi-

increasing reduction of the neutrophil count up to approximately 400 to 500 r, after which further increments in dosage produced no further reduction. It therefore can be assumed that at this dosage level no appreciable myeloid tissue capable of function remained seventy-two hours after ir-
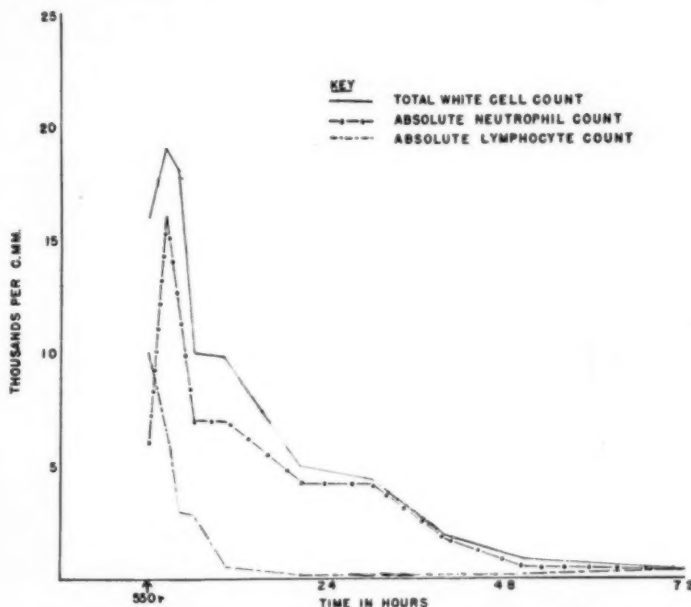

Fig. 3.   Mean changes in the total number of white blood cells, the number of lymphocytes, and the number of neutrophils in the peripheral blood of rats after 550 r whole body irradiation.   (Data of Metcalf and associates.)

mately seventy-two hours after irradiation, when neutrophils were almost totally absent. Regeneration began at approximately twelve days, normal values being restored by the twenty-fifth day.[2] In the series of Bryan, Suter, and associates, the first unequivocal changes were found at seventy-two hours, but it should be noted that in this study counts were made at twenty-four hours after exposure to radiation and, following that, at forty-eight-hour intervals. At seventy-two hours increasing dosage of radiation resulted in

radiation. The neutrophil counts returned to approximately normal levels within twenty-five days in all surviving animals.

(b) *Lymphocytes:* In the experiments conducted by Bryan, Suter, and associates, a dosage of 25 r was found to cause a drop in the lymphocyte level in twenty-four hours. Metcalf and others found a reduction in the peripheral blood lymphocytes of rats exposed to 550 r as early as fifteen minutes after exposure. In their series, the lymphocyte level was reduced to almost zero at the end of fifteen hours. Bryan, Suter, and others found that the reduction of lymphocytes was still apparent after twenty-five days in survivors of all groups receiving 50 r or more. Progressive reduction in the lymphocyte count at

[2] The time intervals specified for beginning regeneration of neutrophils and other cell types (as well as for other events following whole-body irradiation) apply only to the rat. In other species the time factor for a given event may be significantly different.

the twenty-four hour period occurred with increasing dosage of radiation up to and including 100 r, indicating maximal cessation of lymphocyte production at this dosage level for this time interval. Suter *et al.* have shown statistically a reduction of lymphocytes following as little as 5 r.

platelets at 120 hours. The almost immediate reduction in lymphocytes is probably due to the greater radiosensitivity of lymphoid tissue and possibly to less storage of cells, as previously mentioned.

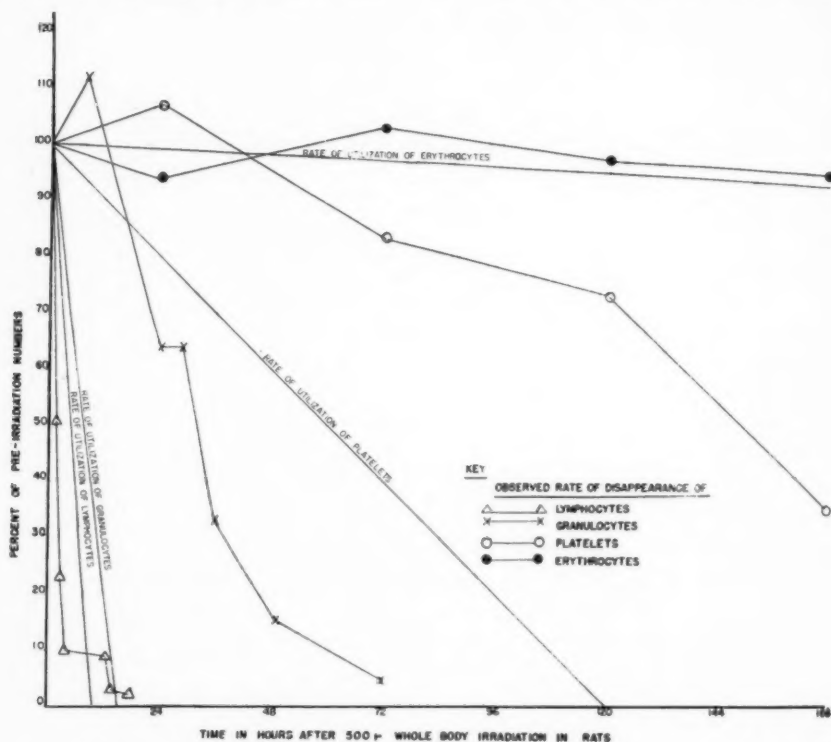Figure 3 shows the actual changes that occurred in the total number of the white

Fig. 4. Comparison of the known rate of utilization of the various cellular elements of the peripheral blood with the observed rate of disappearance of these elements from the peripheral blood of rats receiving 500 r whole body irradiation.

(c) *Total Leukocytes:* The data for total leukocytes show close correlation with those for lymphocytes, since these cells comprise the vast majority of the cells in the peripheral blood of the rat.

If we return to our discussion of the life span or the rate of utilization of the various cellular elements in the blood, it is rather remarkable how closely this is reflected in the above results. Thus, the first definite diminution noted in the lymphocytes was at fifteen minutes, in the granulocytes at twenty-four to thirty-six hours, and in the

blood cells, the number of the lymphocytes, and the number of the neutrophils in the peripheral blood of the rat at various intervals of time after exposure to 550 r (Metcalf and associates).

The data which have just been presented can be reviewed by means of the next two figures. In Figure 4 we have shown by means of heavy lines the known rate of utilization of the lymphocyte, the granulocyte, the platelet, and the red blood cell. Since we did not have these data for the rat, we have used the values obtained in

the cat for the white cells and platelets and those obtained in the dog and man for the red blood cells. The other lines on the chart show the actual rate of disappearance of these peripheral blood elements in the rat at various periods of time after exposure to 500 r. It is readily seen that the

to the 168th hour, it paralleled the line showing the rate of utilization of the red cells.

It is readily seen, therefore, that the rate of disappearance of the various elements is determined to a large extent by their rates of utilization or their life span.
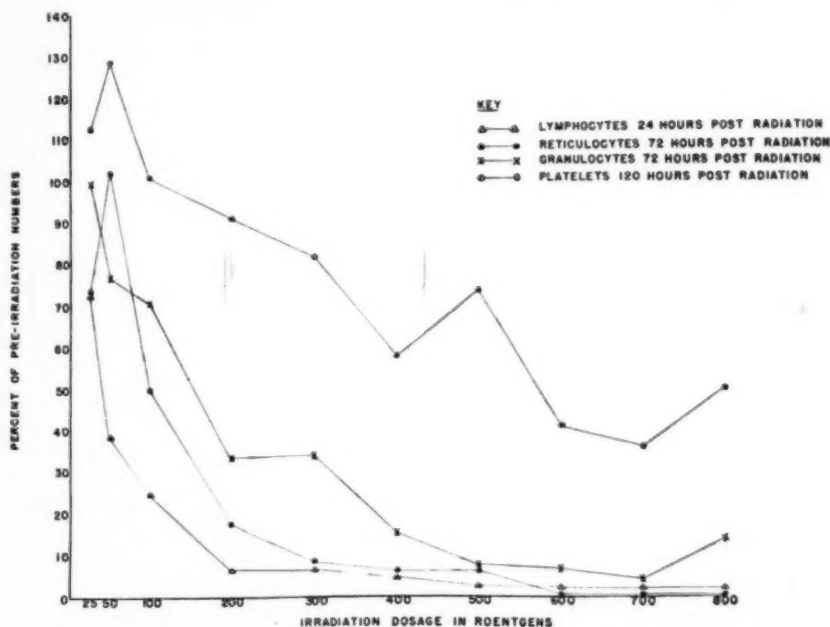

Fig. 5. Changes in the various cellular elements of the blood with increasing doses of radiation. The time chosen for each element was that interval after radiation exposure when definite diminution of that element was first noted. (Data of Suter and associates.)

diminution of lymphocytes was very precipitous, almost all of them being absent twelve hours after irradiation. The line of descent parallels that of the rate of utilization of the lymphocytes. The granulocytes did not show any appreciable diminution until the twenty-fourth to the thirty-sixth hour, but following that their line of descent closely approximated the line showing their rate of utilization. The platelets did not begin to disappear until between seventy-two and 120 hours. The line from seventy-two hours to 168 hours is roughly parallel with that showing their actual rate of utilization.

The rate of disappearance of the red blood cells was very slow; from the 120th

In Figure 5, we have charted the radiation dosage in roentgens against the preirradiation percentages of the various morphological blood elements. As stated in the legend, we have shown the values for each of these elements at that time interval after radiation exposure where definite and appreciable diminution in the numbers of the elements was first noted. Thus, we have used the values at twenty-four hours for the lymphocyte, at seventy-two hours for the granulocyte and the reticulocyte, and at 120 hours for the platelet. We did not use the ten- to twelve-hour period for the lymphocyte even though there is marked and possibly maximal reduction at this period, because there

was only one dosage exposure at that time (550 r—Metcalf and associates). All of the data on this chart were obtained from the studies of Bryan, Suter, and associates. The facts mentioned previously with reference to the effect of various dosages of radiation on the different peripheral blood

debris was rapidly being removed by macrophages. At twenty-four hours after irradiation, regeneration and repair of the lymph nodes were actively progressing, and by the twentieth post-irradiation day regeneration was complete (Metcalf and associates). It should be noted that these
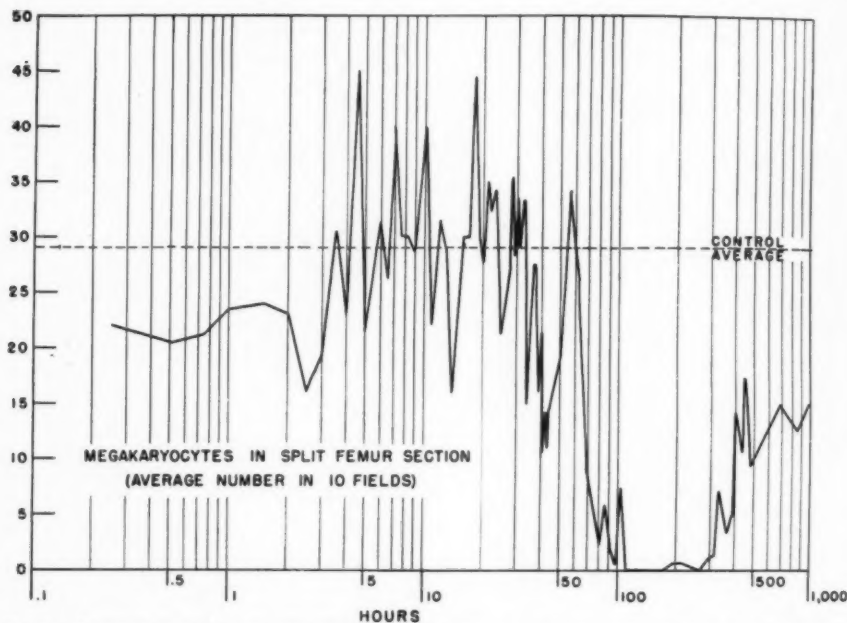

Fig. 6.   Mean changes in the number of megakaryocytes in bone marrow of rats receiving 550 r whole body irradiation.   (Data of Metcalf and associates.)

elements can be visualized by a study of this chart.

CHANGES IN MORPHOLOGY OF THE HEMOPOIETIC TISSUES IN RATS RECEIVING SINGLE DOSES OF RADIATION

Since pathologic changes at different dosage levels of radiation varied chiefly in a quantitative manner, the data obtained at a single dosage level (550 r, which is the approximate L.D. 50 for rats) have been chosen for purposes of illustration (Metcalf and associates). With 550 r, the effects of radiation injury were present at one hour after irradiation (Bryan, Suter *et al.*). At six hours after irradiation, cytolysis of the cells in the lymph follicles had reached its maximum, and the cellular

findings in the lymph nodes did not show good correlation with the peripheral blood picture, since the total number of the lymphocytes in the peripheral blood at the end of twenty-five days was still appreciably below normal.

The changes in the spleen after irradiation followed closely those observed in the lymph nodes except that the whole process was somewhat more prolonged. Regeneration was first observed between the thirtieth and the thirty-fifth hours after irradiation and was not complete until forty days after exposure.

Cellular destruction in the bone marrow reached its maximum between two and a half and five hours after irradiation. Most of the accumulated cellular debris was re-

moved by the thirtieth post-exposure hour. By the eighth day, hypoplasia was very severe, but at no time was complete aplasia observed. Active regeneration began approximately twelve days after irradiation and was completed on the fortieth day.

The greatest reduction in the mega-

which a single dose was employed. Marked differences on the basis of species sensitivity have been found, the rabbit, for example, exhibiting substantially more resistance to the hemopoietic and general lethal effects of radiation than other species studied. These variations in sensitiv-
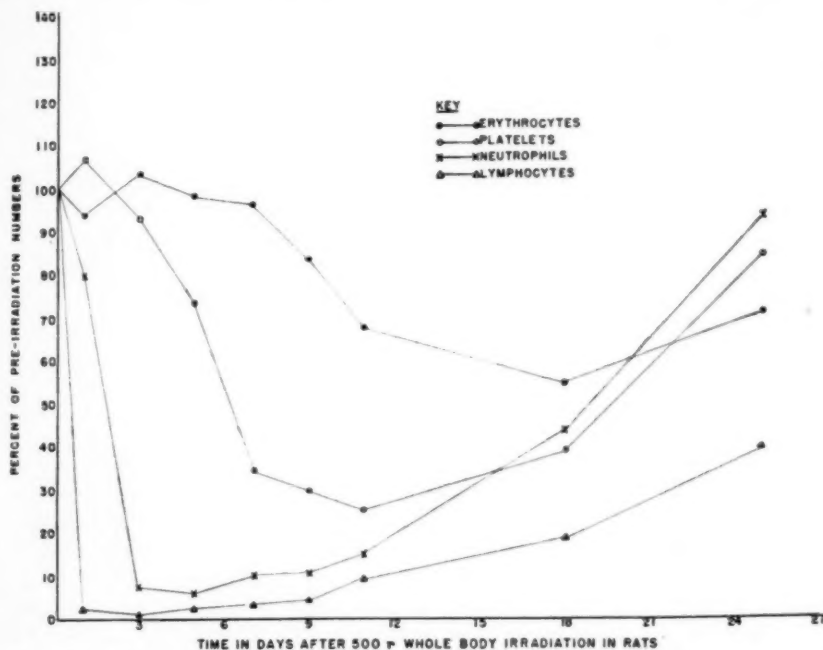

Fig. 7. Time of depression and regeneration of the various cellular elements in the peripheral blood of rats receiving 500 r whole body irradiation. (Data of Suter and associates.)

karyocytes occurred between the fourth and twelfth days, after which regeneration began. This was complete at approximately the forty-first day. Figure 6 shows the changes actually found in the number of the megakaryocytes of the bone marrow at different intervals of time after exposure. Figure 7 shows the time at which regeneration began in the various cellular elements in the peripheral blood.

REPEATED SMALL DOSES OF RADIATION TO BODY AS A WHOLE

Experimental studies on animals exposed repeatedly to small daily doses of roentgen and gamma radiation are even more difficult to summarize than those studies in

ity are largely quantitative rather than qualitative.

While it is difficult to assess accurately all the results at this time, certain generalizations may be regarded as established. First, in the present stage of analysis of the data at the University of Rochester it is not possible to demonstrate unequivocally hemopoietic changes when a daily dose of 1 r a day or less was given over a period of one to two years. Analysis is not yet completed. It is our feeling that 1 r per day is somewhere near the critical dose required to produce detectable hemopoietic changes over a one to two year period in at least some species. Second, in every species studied a daily exposure to 10 r per day re-

sulted in detectable change in some of the hemopoietic elements within a years time. Third, and very important, despite the fact that with small doses of radiation it was not always possible to detect hemopoietic changes, no radiation dosage employed was so small that the mean survival time of large groups of animals was not affected. Thus, total dosage is of great importance and, within limits, the effect of roentgen radiation given in small daily increments is cumulative. It may be surmised, though not proved, that if animals are studied sufficiently long, disturbances in hemopoiesis may be found in some members even where very small daily doses are concerned. Fourth, the incidence of leukemia is definitely increased in animal groups subjected to chronic radiation. Fifth, and last, the question of how much reserve hemopoietic capacity is affected by repeated small doses of radiation insufficient to result in abnormalities under *normal* circumstances is as yet unanswered. The extension of the present limited knowledge of the effects of repeated small exposures to roentgen radiation must be regarded as of utmost importance since, in man, it is this type of exposure which most commonly occurs.

IRRADIATION TO A LOCAL AREA

The effect on the hemopoietic tissue of radiation applied locally to non-hemopoietic tissues has been a source of considerable argument and speculation for a number of years. The occurrence of leukopenia in individuals receiving local radiation in areas where little or no hemopoietic tissue was located has made it seem to some that local irradiation produced a generalized effect on the hemopoietic tissues. We have recently reported observations made in this laboratory on this problem in the cat. We were unable to find any evidence of an effect of radiation on the blood picture of normal cats connected for long intervals of time by carotid anastomoses with irradiated cats at various periods following irradiation. The blood picture of the non-irradiated cat following discon-

tinuation of the carotid anastomosis was the same as in normal animals under these conditions.

Rekers and his associates have made observations on dogs which are in agreement with our findings. Thus, they found that when the whole body was irradiated, with the exception of one extremity, the hemopoietic tissues in the non-irradiated extremity suffered little change other than a slight possible temporary compensatory hyperplasia. Furthermore, the clinical course of the animal and the magnitude of the deflection of the peripheral blood elements was altered less, suggesting that non-irradiated marrow exerts a sparing or maintenance action. Contrariwise, when the body was spared and the two lower extremities were heavily irradiated (2,500 r), there was negligible deflection of the elements of the peripheral blood despite the extreme radiation changes in the marrow, skin, and vascular structure of the irradiated areas.

These observations point strongly to the absence of any direct effect of radiation on hemopoietic tissue not directly in the exposed area. The possibility of some indirect non-specific effect exists, but it does not seem very likely that this could explain the chronic low-grade leukopenia at times encountered in human beings who have received local roentgen radiation over presumptively insufficient amounts of hemopoietic tissue to result in leukopenia. There is much need for critical study of such individuals. In particular, it is extremely important to determine the amount of hemopoietic tissue which has been irradiated in such patients. It may be greater than suspected.

INTERNAL IRRADIATION

The use of radioactive isotopes makes it necessary to consider this form of radiation more thoroughly than previously. The main difference in use of radiation of this type is that alpha and beta radiations can, with the use of suitable isotopes, produce changes in tissues that would not ordinarily be reached by these radiations. The

possibility of giving radiation to special cells and tissues without affecting other tissues is a very interesting and important consideration. If radioactive isotopes can be found with high specificity for different tissues, it should be possible to accomplish much by such agents. Work on the thyroid gland represents only one important clinical application of this form of radiation therapy. In so far as the blood is concerned, little more seems to have been accomplished by the use of radioactive phosphorus than by roentgen rays. It is not the purpose of this paper to discuss in any detail the use of radioactive isotopes. It is intended merely to call attention to this type of radiation and to mention how it differs from roentgen radiation.

EFFECT OF NEUTRONS

There is not a great deal to be said on this subject. Henshaw and his group have reported on the effect of neutrons on the hemopoietic tissue of CF_1 mice. They gave small doses on repeated occasions. In their opinion, 4.3 n per day for six days a week produced a steady downward drop in the total white blood cell count, involving both lymphocytes and neutrophils. They interpreted their data as showing no changes in the peripheral blood of animals receiving 1.15 n daily. They felt that the threshold responses of the peripheral blood were at least a factor of ten less sensitive than survival responses in CF_1 mice. The r/n ratio varied between eight to one and thirty-five to one.

The late pathological effects of neutron radiation were general atrophy and neoplasia of the hemopoietic organs. The degree of acute damage varied with the dose and with the intensity of the radiation; that is, the effect was less with an increase in the exposure time.

Failla and Evans have also made observations on the effect of fast neutrons on mice. They found that 8 r gave almost the same effect as 1 n when the percentage of survival, the median lethal time, and the hematological effects were used as indices of comparison.

EFFECT OF TOTAL BODY IRRADIATION ON COAGULATION OF THE BLOOD AND HEMORRHAGIC MANIFESTATIONS

Considerable important work on the effect of total body irradiation on blood coagulation and hemorrhagic manifestations has been done by Allen and his associates. In short, they have shown that in the dog hemorrhagic manifestations could not be explained by platelet reduction *per se*. They have presented strong evidence for the assumption that the hemorrhagic manifestations are due in these animals to the liberation of heparin in large amounts as the result of irradiation. Various antiheparin substances—toluidine blue, certain thionin dyes, and protamine—have been shown to have a very salutary effect on the coagulation defect in radiation sickness of the dog. It has further been possible to isolate from the blood of such dogs a substance which Allen *et al*. consider probably to be heparin. This is a most important observation and changes our concept about hemorrhagic manifestations in radiation sickness a great deal. Further work in this connection will be observed with much interest.

EFFECT OF RADIATION ON MAN

The purpose of all of the studies which have been reviewed is to get a better idea of the effect of radiation on man. Acute experiments dealing with the effect of radiation on the whole body are not of tremendous practical importance, as it seldom happens that human beings are so exposed. However, such exposures do occur and do, within limits, result in changes of much the same nature as reported in the rat. Thus, leukopenia, thrombopenia, and anemia were found in some of the Japanese who were within the area where radioactivity developed immediately following detonation of the atomic bombs. These individuals received essentially single doses of whole body radiation, since it has been shown that residual radiation in these areas was unimportant. The order of development of the blood changes was (1)

leukopenia; (2) thrombopenia; (3) anemia.

Most human exposures, however, are likely to be in the nature of small amounts received repeatedly. Results of such experiments are not as clear cut as are those with single exposures. Nevertheless, certain general deductions can be reached from the animal experiments. It is most important in this connection to understand that there is much work indicating that exposure to radiation is *cumulative*. In other words, the total amount of radiation to which an individual has been exposed is a very important factor in the lesions which he may develop, regardless of the time elapsing during the period of exposure. This should not be construed as meaning that the rate at which radiation is given has nothing to do with the final effect on the individual, for there is considerable evidence indicating that toxic reactions are not the same in acute radiation exposure of large amounts as in chronic repeated exposure. However, it does mean that the total amount of radiation exposure is a very important determinant as regards the pathological changes occurring in any individual. Minimal exposure becomes important if repeated often enough to result in a significant *cumulated* dose. Furthermore, the possibility of the development of leukemia and allied disorders must be considered in every instance when there is exposure to radiation of any appreciable amount. The incidence of leukemia has, in repeated instances, been found to be higher in susceptible animals exposed to radiation than in those not so exposed. This does not need to be interpreted as meaning that chronic irradiation will produce leukemia. It may be that radiation merely causes the more rapid development of a process that would develop in time anyway. Be that as it may, leukemia is certainly found more commonly in men and in animals exposed to chronic irradiation than in normal animals or men. Such observations naturally raise the question of long-term results of irradiation. One can very properly wonder whether anemia,

leukopenia, thrombopenia, leukemia, or other hemopoietic disorders will develop in a higher percentage of individuals who have been exposed to radiation, even though in very small amounts, than in unexposed individuals. Time will be required to answer this. Until we have the answer, it will be important to go slowly in our interpretation of the end-results of irradiation of either animals or man.

From a practical standpoint it has seemed to us very important to consider any change from normal in the blood of a human being with possible exposure to radiation as due to radiation until proved not to be. Thus, polycythemia as well as anemia, leukocytosis as well as leukopenia, and thrombocytosis as well as thrombopenia must all be considered as being possibly due to radiation in those who have been exposed. Also, changes in the differential formula must be so interpreted. It has been our experience over a number of years, that in man leukopenia is the most common finding with chronic exposure to small amounts. This leukopenia is associated with diminution in both neutrophils and lymphocytes. The degree of the leukopenia, however, is more closely associated with the neutrophils since these cells are normally much more abundant in the blood of man than are the lymphocytes. Other changes than leukopenia do occur, of course, but are not so common.

This discussion should not be closed without calling attention to the close similarity between hemopoietic changes in chronic radiation exposure and chronic benzol intoxication. Thus, in both conditions the same changes may occur in the peripheral blood and the bone marrow, the incidence of leukemia is increased and, finally, apparent recovery may be followed by the sudden development of severe anemia or other blood abnormalities.

In conclusion, it may be said that we are just beginning to see some of the results of chronic radiation exposure. As pointed out, the cumulative effect is established, the incidence of leukemia is increased, and finally, changes may develop after appar-

ent recovery. What additional effects of chronic irradiation will be found, we are unable to say.

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SUMARIO

Efecto de la Irradiación sobre la Hematopoyesis

Preséntanse observaciones relativas a los efectos hematopoyéticos de la radiación administrada de diversos modos.

La mayor parte de las observaciones referentes a la irradiación con dosis única de todo el cuerpo han sido ejecutadas en animales. Parece que el cuadro hemoperiférico es decididamente afectado en cualquier período postirradiatorio por la duración de la vida o velocidad de la utilización de los diversos elementos morfológicos en la sangre. Por ej., después de una dosis de 500 r, la disminución de los linfocitos fué muy precipitada, reflejando la breve duración de su vida, observándose la primera disminución a los quince minutos. Los granulocitos no revelaron baja apreciable hasta al cabo de 24 a 36 horas. Las plaquetas comenzaron a desaparecer al cabo de 72 a 120 horas, y los hematíes entre 120 y 168 horas.

Tras dosis de 200 r o menos se observó muy poca o ninguna alteración de los eritrocitos o plaquetas. Cuando la dosis era inferior a 100 r, no se notó mayor reducción de los reticulocitos. Sin embargo, una dosis de 25 r hizo bajar la fórmula linfocitaria en término de 24 horas.

Los estudios experimentales del efecto de pequeñas dosis repetidas dan resultados menos bien definidos; pero en todas las especies estudiadas una exposición diaria a 10 r fué seguida de alteraciones distinguibles en algunos de los elementos hematopoyéticos en término de un año. A pesar de que, con dosis pequeñas, no siempre podían descubrirse alteraciones hematopoyéticas, no hubo dosis tan pequeña que no afectara el tiempo de sobrevivencia medio de grandes grupos de animales, por lo cual es aparente que la dosis total es importante y que el efecto de los rayos X en pequeños aportes diarios resulta acumulativo. La incidencia de leucemia aumentó netamente en los animales expuestos repetidamente a pequeñas dosis de radiación.

Los experimentos en animales apuntan claramente a la conclusión de que la irradiación local no produce efecto directo sobre los tejidos hematopoyéticos que no quedan directamente en la región expuesta.

Como la mayor parte de las exposiciones humanas a la irradiación toman probablemente la forma de pequeñas dosis repetidas, las deducciones más importantes de los estudios experimentales aquí presentados radican en la observación relativa al efecto acumulativo y la importancia de la dosis total de radiación recibida en la producción de alteraciones patológicas. Además, hay que considerar la posibilidad de leucemia y enfermedades afines siempre que haya exposición a una cantidad considerable de rayos X. Por fin, una reposición aparente puede ir seguida de la súbita aparición de anemia grave u otras hemodiscrasias.

EDITORIAL

The Photopic Fluoroscope

The limited amount of x-ray that one is warranted in putting through a patient for diagnostic purposes and the finite efficiency of even the best of fluoroscopic screens in turning the x-ray into visible light have until now doomed the roentgenoscopist to work with very low brightnesses. Nearly seven years ago, in his Carman Lecture before the Radiological Society of North America, Dr. W. Edward Chamberlain discussed this shortcoming of fluoroscopy. He referred to a patent of Langmuir's covering a design to increase the brightness on the fluoroscopic screen by electron acceleration. How much further Langmuir went with this we do not know. At any rate, no such instrument is listed in the General Electric X-ray catalogue, and radiologists are still waiting to get it, some quite impatiently. Recently another company (Westinghouse) announced to the press that they had designed a successful instrument for increasing very greatly the brightness of the fluoroscopic image. This device is described by Dr. John W. Coltman in this number of RADIOLOGY.[1]

Many radiologists, observing recent triumphs of television engineering, have wondered why those technics have not been put to work to solve this same problem of fluoroscopic image brightness. Moon's description of such a plan appeared soon after the Westinghouse announcement.[2]

Coltman's machine catches the x-ray on a fluoroscopic screen, just as in ordinary fluoroscopy, but the light from this is used immediately to excite a photoelectric surface. The "picture" is now expressed in electrons, which are then accelerated by an electric field and focused on a fluorescent screen, as in a snooperscope. The amplification, *i.e.*, the gain in energy needed to multiply the brightness, is got from the accelerating field, some 20,000 volts. The focusing is by an electron lens, electromagnetic or electrostatic, as in an electron microscope. By focusing a 5-inch area down to a 1-inch image, the electrons are crowded into one twenty-fifth the area, this providing another large factor of gain. The small bright image is viewed by means of an optical system of large aperture and sufficient magnification. The back of the viewing screen is covered with exceedingly thin aluminum, sufficiently transparent to the 20,000-volt electrons, but opaque to the light which would otherwise feed back onto the photoelectric surface and make the tube "run away." We are promised screen brightnesses 500 times what we have been using.

Moon's scheme involves a special x-ray tube which sweeps a very fine focal spot over a very broad target. Using a pinhole in a lead shield, this gives a fine beam of x-ray scanning the portion of the patient under examination. A screen made of a mosaic of clear calcium tungstate crystals lights up in proportion to the transmitted intensity of this scanning x-ray beam. The fluorescent light is picked up and amplified by a photomultiplier tube and the current fed into a television receiver synchronized with the sweep circuit of the x-ray tube. It would seem that one could make the television tube run as bright as one desires.

Both methods have limitations. Moon's scheme throws away all but one part in 15,000 of the x-ray if one scans a 10-×15-cm. area with a 1-mm. spot. It is true

[1] See page 359.
[2] MOON, R. J.: Am. J. Roentgenol. **59**: 886–888, June 1948.

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that the patient is protected from x-ray in the same ratio, but engineering considerations seem to limit the tube current to about 100 ma., which is 20 times the usual fluoroscopic load, not 15,000 times. Statistical fluctuations in such a tiny sample of the quantum flux from the tube might make the image very irregular. Coltman's tube has to overcome the poor efficiency of conversion of the fluorescent light into photoelectrons at its cathodal surface but does not increase the statistical fluctuations.

When we have these machines in actual operation, we can then observe whether Coltman's is actually bright enough and whether Moon's is smooth enough. But supposing either or both prove successful, what then can we expect in clinical use? To answer this requires a nice estimate of the shortcomings of present fluoroscopy in the face of the known diagnostic capabilities of x-ray if used "to the hilt."

As proof that fluoroscopy has its shortcomings, one need only observe the dominance of roentgenography. Why do we continue to make routine use of films and put up with the cost and delay? It is because we can't see well enough fluoroscopically. It is not that the screen doesn't hold the detail. Obviously the detail is excellent, as seen preserved in double screen radiographic technic. The defect is in our vision, which sadly lacks acuity and contrast discrimination at low brightness levels. Precise vision is a foveal function (retinal cones), and the fovea just about

abdicates (to the rods) in very dim light, until at the lowest brightness levels we all have in effect a central retinal scotoma.

We can hope that the new machine, operating at higher brightness levels, will overcome these physiological shortcomings. If these hopes are realized, then the new fluoroscopy will yield everything that roentgenography and fluoroscopy now yield in combination, except the permanent record.

It looks as if the radiologist can expect more critical demands upon his diagnostic acumen. He will see every patient personally and every patient will see him. He can hope to have the referring physician more often at his elbow, no longer deterred by the long time for dark adaptation (unless he comes from out of doors, two or three minutes will give optimum adaptation). Moreover, there will often be no film, and if the physician wishes to see for himself, he can do it only at the time of the fluoroscopy.

It will be the radiologists' reports which are referred to, not their films. If doubt arises, one can only examine the patient again, as is the case with other medical consultation. The responsibility will be increased, but also the importance and the opportunities of radiology. It might mean a revolution in the practice of the medical specialty of diagnostic radiology, for films have been impersonal, but words spoken in consultation, or written in a report, are personal and professional.

R. R. NEWELL, M.D.

Invitation to San Francisco

Seven eventful years have passed since the Radiological Society last met in California. It is therefore with pride and pleasure that we again invite all radiologists, but especially the members of the Radiological Society of North America, to attend the annual meeting to be held in San Francisco, Dec. 5 to 10, 1948.

An unusually stimulating program has been arranged. It will consist of a series of symposia, of groups of related papers, of scientific exhibits, and refresher courses, and will include "A Wet Clinic on the Practical Use of Isotopes."

Dr. Merrill Sosman will give the Carman Lecture and, as might be expected, has chosen a most interesting topic.

The refresher courses in diagnosis and therapy have been revised and expanded. They are outlined on the following pages.

Plan now to attend the December meeting. San Francisco and the Pacific Coast will uphold their reputation for hospitality, and the papers and exhibits will make your visit well worth while.

L. HENRY GARLAND, M.D.
President

The 1948 Refresher Courses will be presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America at the Hotels Fairmont and Mark Hopkins, San Francisco, Calif., Dec. 5–10.

The courses will open Sunday afternoon, Dec. 5, at 1:30. Three courses will be given on Sunday, two in the afternoon, and one, the ever-popular Film-Reading session, in the evening from 7 to 9. We have changed this meeting so that there will be no conflict with any other.

After Sunday, there will be five courses daily, from 8:30 to 10 A.M. No other meetings will be scheduled for these hours, and, in so far as possible the courses have been so arranged that those interested in a particular subject may enroll in a related series.

Admission will be by ticket only, except for the Film-Reading session, which will be open to all.

Non-members will be charged $2.00 for each course up to a maximum of $10.00 for the entire series. Reserve officers still on active duty and residents and fellows in radiology will be exempt from these charges.

Read the description of the courses, noting particularly the days upon which they are offered, and make your selection for each day. State your first, second, and third preferences, as in some instances the number attending each course must be limited and reservations will be made in the order in which applications are received.

Upon receipt of your application you will be notified, but your tickets will be held for you at the registration desk at the Fairmont Hotel. If the courses are not filled by the time of the meeting, tickets will be available at the registration desk.

It may be necessary to revise some of the courses or to change some of the instructors. We shall, however, adhere as closely as possible to the program as outlined below.

Course No. 1: Sunday, 1:30–3:30 P.M.

Roentgenologic Manifestations of Acute Abdominal Diseases

LEO G. RIGLER, M.D.
University of Minnesota
Minneapolis, Minn.

1. Roentgen technic in acute abdominal disorders: Variations from the usual technic of abdominal examination, the difficulties, and special procedures necessary will be detailed.
2. Indications for roentgen examination in the acute abdominal disorders: The various acute processes in the abdomen in which roentgen examination is of great assistance in establishing either the diagnosis or aiding in determining the extent and nature of the process will be presented.
3. Analysis of the scout film of the abdomen: (a) The normal appearance of the roentgenogram of the abdomen without contrast medium. The soft-tissue shadows, the appearance of the gastro-intestinal tract with and without preparation and under varying conditions will be demonstrated.

(b) The abnormal roentgenogram without contrast medium. A discussion of the physiologic and pathologic factors in the production of changes in the abdomen will be undertaken. An analysis of the various findings which may be obtained with different types of acute abdominal disorders and their differential diagnosis will be presented.

Demonstrations will be given of the findings in:
(1) Peritonitis.
(2) Intra-abdominal abscess.
(3) Small intestinal obstruction.
(4) Large intestinal obstruction.

4. Value of x-ray examination in the acute abdominal disorders: The reliability of the various x-ray signs and their contribution toward the practical handling of the patient will be discussed.

Course No. 2: Sunday, 3:30–5:30 P.M.

Biological Foundations of Radiotherapy

ISADORE LAMPE, M.D.
University of Michigan
Ann Arbor, Mich.

General considerations of the interaction of radiation and living tissue on the cellular and tissue level, with emphasis on various general biological concepts which observation and experience have shown to be of probable importance.

Course No. 3: Sunday, 7–9 P.M.

Film Reading Session

MERRILL C. SOSMAN, M.D.
Peter Bent Brigham Hospital, Boston, Mass.
Presiding

JOHN D. CAMP, M.D., Mayo Clinic
L. HENRY GARLAND, M.D., San Francisco, Calif.
A. O. HAMPTON, M.D., Washington, D. C.
FRED J. HODGES, M.D., University of Michigan
LEO G. RIGLER, M.D., University of Minnesota

This is an opportunity for the members to present their interesting cases, but, in order to make this session of real teaching value, it has been decided that all cases must be approved by Dr. Sosman in advance and must fulfill certain requirements, namely,

(1) They must be proved beyond a reasonable doubt.

(2) It must be possible to make the correct diagnosis either from the x-rays, history, physical examination, laboratory findings, or any combination of these.

(3) They must be of interest and of teaching value.

Anyone desiring to present cases should write directly to Ivan J. Miller, M.D., 49 4th St., San Francisco 3, Calif., or to Merrill C. Sosman, M.D., Peter Bent Brigham Hospital, Boston, Mass., outlining the case and the proof. If the case is accepted, the one presenting it will be asked to make lantern slides (standard, $3^1/_4 \times 4^1/_4$-inch size) and to bring the original films for the "experts." No cases can be considered that are submitted later than Nov. 1.

Course No. 4:   Monday, 8:30–10 A.M.

The Radiologic Aspects of Urinary Tract Disease

FRED J. HODGES, M.D.

University Hospital
Ann Arbor, Mich.

X-ray methods employed in the field of urology will be reviewed. The pathological situations which can be detected by such procedures will be summarized and illustrated. Desirable relationships between urologist and radiologist will be discussed.

Course No. 5:   Monday, 8:30–10 A.M.

Ventriculography

JOHN D. CAMP, M.D.

Mayo Clinic
Rochester, Minn.

This course will cover the fundamentals of ventriculography, consisting of:

(1) Indications for examination.
(2) Technic of examination.
(3) Normal anatomy.
(4) Common sources of error due to:
  (a) Improper technic of examination.
  (b) Insufficient filling.
  (c) Pseudo displacements.
(5) Intraventricular lesions.
(6) Extraventricular lesions.

(Continued Tuesday. See Course No. 10)

Course No. 6:   Monday, 8:30–10 A.M.

Practical Problems in X-Ray Dosage Measurements

MARVIN M. D. WILLIAMS, Ph.D., Physicist

Mayo Clinic
Rochester, Minn.

1. Effect of kilovoltage, milliamperage, filtration, and focal-skin distance on the radiation roentgen output of an x-ray machine as measured in air.

2. Effect of quality of radiation, size of field, and depth of underlying tissue on back-scatter.

3. Effect of quality of radiation, size of field, and focal-skin distance on penetration of the radiation into the tissue, or depth dose.

4. Isodose charts. Determination of radiation intensity in roentgens, and quality in half-value layer and effective wave length.

5. Scattering and total absorption of photons in the tissue.

6. Discussion of the record sheet as recommended by Standardization Committee of the Radiological Society of North America.

Course No. 7:   Monday, 8:30–10 A.M.

Diagnosis and Treatment of Tumors of the Lymphoma Group

JUSTIN J. STEIN, M.D.

College of Medical Evangelists
and
JOHN W. BUDD, M.D.

Los Angeles Tumor Institute
Los Angeles, Calif.

Dr. Budd will present the diagnosis and classification of the tumors of the lymphoma group; Dr. Stein surgical and radiological management, as well as treatment with isotopes and nitrogen mustard.

Courses No. 8 and 13:   Monday and Tuesday, 8:30–10 A.M.

Classification and Methods of Diagnosis and Treatment of Tumors of the Female Genital Tract

A. N. ARNESON, M.D.

Washington University
St. Louis, Mo.

The classification of cervical and corpus lesions will be discussed, as well as the gross appearance of different lesions and the relation of those findings to treatment. An attempt will be made to discuss treatment on the basis of arrangement of radium and the dose per source. Preoperative irradiation and transvaginal irradiation for lesions of both the cervix and the corpus will be taken up.

Course No. 9:   Tuesday, 8:30–10 A.M.

Diseases of the Gallbladder with Remarks on Cholangiography and Pertinent Pancreatic Disorders

WENDELL G. SCOTT, M.D.

Washington University School of Medicine
St. Louis, Mo.

This course includes a brief summary of the development and the technics of cholecystography

SUNDAY, Dec. 5 1:30–3:30 P.M.	MONDAY, Dec. 6 8:30–10 A.M.	TUESDAY, Dec. 7 8:30–10 A.M.
1. Roentgenologic Manifestations of Acute Abdominal Diseases Leo G. Rigler, M.D.	4. The Radiologic Aspects of Urinary Tract Disease Fred J. Hodges, M.D.	9. Diseases of the Gallbladder with Remarks on Cholangiography and Pertinent Pancreatic Disorders Wendell G. Scott, M.D.
	5. Ventriculography *(Continued Tuesday)* John D. Camp, M.D.	10. Encephalography *(Continued from Monday)* John D. Camp, M.D.
3:30–5:30 P.M. 2. Biological Foundations of Radiotherapy Isadore Lampe, M.D.		
	6. Practical Problems in X-Ray Dosage Measurements Marvin M. D. Williams, Ph.D.	11. Practical Problems in Radium Dosage Measurements Edith H. Quimby, Sc.D.
	7. Diagnosis and Treatment of Tumors of the Lymphoma Group Justin J. Stein, M.D. John W. Budd, M.D.	12. Roentgen Diagnosis of Diseases of the Chest *(Continued Wednesday)* Ray A. Carter, M.D.
7–9 P.M. 3. Film Reading Session Merrill C. Sosman, M.D. John D. Camp, M.D. L. Henry Garland, M.D. A. O. Hampton, M.D. Fred J. Hodges, M.D. Leo G. Rigler, M.D.		
	8. Classification and Methods of Diagnosis and Treatment of Tumors of the Female Genital Tract *(Continued Tuesday)* A. N. Arneson, M.D.	13. Classification and Methods of Diagnosis and Treatment of Tumors of the Female Genital Tract *(Continued from Monday)* A. N. Arneson, M.D.

PRESENTATION

WEDNESDAY, Dec. 8 8:30–10 A.M.	THURSDAY, Dec. 9 8:30–10 A.M.	FRIDAY, Dec. 10 8:30–10 A.M.
14. Roentgenology of the Esophagus, Stomach, and Duodenum Frederic E. Templeton, M.D.	19. Roentgenologic Findings in the Small Intestine Ross Golden, M.D.	24. Roentgenologic Diagnosis of Diseases of the Colon David G. Pugh, M.D.
15. Roentgenological Findings and Differential Diagnosis of Skeletal Diseases *(Continued Thursday)* Paul C. Hodges, M.D.	20. Roentgenological Findings and Differential Diagnosis of Skeletal Diseases *(Continued from Wednesday)* Paul C. Hodges, M.D.	25. Tumor Pathology as Applied to Irradiation Therapy John W. Budd, M.D. Justin J. Stein, M.D.
16. Dosage Problems in Isotopes and Health Protection H. M. Parker	21. Radiotherapy for Neoplasms of the Pharynx and Larynx William Harris, M.D.	26. Clinical Use of Radioactive Isotopes B. V. A. Low-Beer, M.D. Earl R. Miller, M.D.
17. Roentgen Diagnosis of Diseases of the Chest *(Continued from Tuesday)* Ray A. Carter, M.D.	22. Roentgen Diagnosis and Treatment of Neoplastic Disease in Childhood Edward B. D. Neuhauser, M.D.	27. Variations of the Normal Chest in Infancy and Childhood Edward B. D. Neuhauser, M.D.
18. Application of Fundamental Principles of Radiation Therapy *(Continued Thursday)* Simeon T. Cantril, M.D.	23. Application of Fundamental Principles of Radiation Therapy *(Continued from Wednesday)* Simeon T. Cantril, M.D.	28. Treatment of Cancer of the Oral Cavity J. A. del Regato, M.D.

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with a present-day appraisal of the intravenous and oral methods, using compounds of tetraiodophenol-phthalein and of the chemical, iodo-alphionic acid (Priodax).

Included in this course is a discussion of the uses of fatty meals and an evaluation of cases with delayed emptying of the gallbladder. There will be a review of experience in evaluating the clinical significance of faint concentrations of the compound in the interpretation of cholecystograms.

The indications for cholangiography and the technics as employed at the Washington University School of Medicine will be presented for discussion, along with those employed elsewhere.

An accurate and objective method for the diagnosis of pancreatic disease is still lacking and presents a challenging problem for solution. A few of the radiographic procedures that are employed in the diagnosis of pancreatic diseases will be demonstrated in the discussion of this problem.

Course No. 10:　Tuesday, 8:30–10 A.M.

Encephalography

JOHN D. CAMP, M.D.

Mayo Clinic
Rochester, Minn.

(Continued from Monday. See Course No. 5)

This course will cover the fundamentals of encephalography, consisting of:

(1) Indications for examination.
(2) Method of air injection and position of patient as influencing ventricular and subarachnoid filling.
(3) Normal anatomy.
(4) Common sources of error due to:
　(a) Improper or incomplete examination.
　(b) Insufficient filling.
　(c) Pseudo filling defects.
(5) Developmental anomalies.
(6) Degenerative lesions.
(7) Inflammatory lesions.
(8) Post-traumatic lesions.
(9) Space-occupying lesions.

Course No. 11:　Tuesday, 8:30–10 A.M.

Practical Problems in Radium Dosage Measurements

EDITH H. QUIMBY, Sc.D., Physicist

Columbia University
New York, N. Y.

The development of dosage units for radium therapy will be traced briefly. Various charts and tables for determination of dosage in roentgens will be presented, and precautions regarding their use discussed. Most of the period will be devoted to working out practical problems. (An exhibit on dosage calculation will probably be presented.)

Courses No. 12 and 17:　Tuesday and Wednesday, 8:30–10 A.M.

Roentgen Diagnosis of Diseases of the Chest

RAY A. CARTER, M.D.

Los Angeles, Calif.

This topic will be presented employing as a point of departure certain rather broadly defined types of abnormal appearances on the film.

The diagnostic possibilities of such appearances will be presented. Differentiation will be sought from details of these appearances, their localization, accessory roentgen examination, other associated roentgen manifestations, associated clinical facts, and from progress of the lesions.

In some cases the diagnosis may be clear on roentgen examination alone. In others the correlation of all available information is required.

Course No. 13:　Tuesday, 8:30–10 A.M.

Classification and Methods of Diagnosis and Treatment of Tumors of the Female Genital Tract

A. N. ARNESON, M.D.

Washington University
St. Louis, Mo.

(Continued from Monday. See Course No. 8)

Course No. 14:　Wednesday, 8:30–10 A.M.

Roentgenology of the Esophagus, Stomach, and Duodenum

FREDERIC E. TEMPLETON, M.D.

University of Washington Medical School
Seattle, Wash.

The course is divided into two parts. In the first part, the normal esophagus, stomach, and duodenum are described. A considerable portion of this discussion is given to describing the usage of the spot machine.

In the second part, the more common lesions found in the esophagus, stomach, and duodenum are described. Particular attention will be given to the differential diagnosis. The talk will be profusely illustrated with lantern slides.

Course No. 15:　Wednesday 8:30–10 A.M.

Roentgenological Findings and Differential Diagnosis of Skeletal Diseases

PAUL C. HODGES, M.D.

University of Chicago
Chicago, Ill.

This course and Course No. 20 are a continuation

REFRESHER SERIES

THE RADIOLOGICAL SOCIETY
OF NORTH AMERICA

December 5 through December 10, 1948

FAIRMONT HOTEL
SAN FRANCISCO, CALIFORNIA

(Detach here)

To Register for the Refresher Courses
FILL OUT THE FOLLOWING

(Print or type)

	First Choice	Second Choice	Third Choice
	Course No. / Instructor	Course No. / Instructor	Course No. / Instructor

Last Name .... **First Name or Initials**

.... **Street Address** ....

City .... **State**

CHECK THE FOLLOWING

Member R.S.N.A. ☐   Guest ☐

M.D............Yes ☐   No ☐

Resident or Graduate Student in Radiology ☐

Where.................

Reserve Officer on Active Duty ☐

Fill out, also, the enrollment diagram on the reverse side of this page

REFRESHER SERIES

INSTRUCTIONS FOR ENROLLMENT

Read the accompanying description of the courses and study the plan of presentation. It is important that you register early; the number admitted to each course will be limited by the seating capacity of the room. Reservations will be made in the order of the receipt of request, and tickets will be held for you at the Registration desk at the Fairmont Hotel, beginning November 30.

FEES

Members: No charge.

Non-Members: $2.00 for each course up to maximum of $10.00 for entire series.

Graduate students and residents in Radiology, reserve officers on active duty: No charge.

(Fees should accompany applications)

PLEASE INDICATE YOUR FIRST, SECOND AND THIRD CHOICES

	First Choice		Second Choice		Third Choice	
	Course No.	Instructor	Course No.	Instructor	Course No.	Instructor
Sunday, Dec. 5 1:30 to 3:30 P.M. 3:30 to 5:30 P.M. 7–9 P.M.						
Monday, Dec. 6						
Tuesday, Dec. 7						
Wednesday, Dec. 8						
Thursday, Dec. 9						
Friday, Dec. 10						

Prior to Nov. 20, 1948, send this order sheet to:
C. Edgar Virden, M.D., Chairman, Refresher Course Committee
320 West 47th St., Kansas City 2, Missouri

After Nov. 20, 1948, mail to:
C. Edgar Virden, M.D., c/o Radiological Society of North America
Fairmont Hotel, San Francisco, Calif.

(*Note:* Your tickets will not be mailed to you but will be given to you when you register for the meeting.)

Fill out, also, the enrollment diagram on the reverse side of this page

of courses 12 and 17 that were presented at the Boston meeting in 1947. This time the 8 × 10 transparencies will be shown not on ordinary viewing boxes but by means of a special projector and a screen.

The first lecture will deal with benign and malignant primary neoplasm of bone and metastatic neoplasm of bone.

(Course continued on Thursday. See Course No. 20)

Course No. 16:   Wednesday, 8:30–10 A.M.

Dosage Problems in Isotopes and Health Protection

H. M. PARKER

Nucleonics Department, General Electric Co.
Hanford Works, Richland, Wash.

1. Elementary calculations of dose.
   (a) Sheets of active material.
   (b) Large masses of active material.
   (c) Dose in body organs.

2. Measurements of dose.
   (a) Extrapolation chamber.
   (b) Radio-autographs.
   (c) Indirect methods.

3. Laboratory hazards.
   (a) External radiation: whole body gamma radiation.
   (b) External radiation: whole body beta radiation.
   (c) External radiation: local exposures— hands, etc.
   (d) Ingestion.
   (e) Inhalation.
   (f) Injection—wounds, etc.

4. Instruments and technics for protection.

Course No. 17:   Wednesday, 8:30–10 A.M.

Roentgen Diagnosis of Diseases of the Chest

RAY A. CARTER, M.D.

Los Angeles, Calif.

(Continued from Tuesday. See Course No. 12)

Courses No. 18 and 23:   Wednesday and Thursday, 8:30–10 A.M.

Application of Fundamental Principles of Radiation Therapy

SIMEON T. CANTRIL, M.D.

Tumor Institute of Swedish Hospital
Seattle, Wash.

I.   General indications for radiation therapy. Selection of the patient. Palliative vs. curative therapy.

Choice of method of irradiation. Combination of surgery with radiation therapy. Combination of radium and x-ray therapy.

II.   Fundamental principles. Importance of diagnosis relative to the biologic properties and possible spread of the growth. Stromal vs. tumor response and preservation of normal tissues. Clinical guides to stromal and tumor response. Protraction as a means of minimizing injury. Its application and limitations. Dose as a factor in radiation therapy.

III.   Roentgen therapy. Importance of the quality of radiation. Selection of fields and their application. Sparing injury to normal tissues. Radiation sickness. Early and late radiation reactions. (The above illustrated by a discussion of the management of cancer of the skin, lip, oral cavity, pharynx, and cervix.)

IV.   Radium therapy. Indications for radium therapy. Intracavitary radium in cancer of the cervix. Limitations of radium as a therapeutic agent.

V.   Questions and discussions.

Course No. 19:   Thursday, 8:30–10 A.M.

Roentgenologic Findings in the Small Intestine

ROSS GOLDEN, M.D.

Presbyterian Hospital
New York, N. Y.

The roentgenographic findings in disturbances in mobility and mucosal pattern of the small intestine, associated with primary and secondary nutritional deficiency states, will be illustrated and discussed. Also, the findings in some cases of intestinal tumors will be shown and comments made. The session will include remarks upon the normal anatomy and the basic principles of intestinal movement.

Course No. 20:   Thursday, 8:30–10 A.M.

Roentgenological Findings and Differential Diagnosis of Skeletal Diseases

PAUL C. HODGES, M.D.

University of Chicago
Chicago, Ill.

This is the second of two lectures, of which the first is scheduled for Wednesday (Course No. 15). This second lecture deals with rickets, scurvy, aseptic necrosis, and osteomalacia.

Course No. 21:   Thursday, 8:30–10 A.M.

Radiotherapy for Neoplasms of the Pharynx and Larynx

WILLIAM HARRIS, M.D.

Mt. Sinai Hospital
New York, N. Y.

The course will deal with the use of x-rays and radium in the treatment of benign and malignant neoplasms of the pharynx and larynx.   Methods of diagnosis and the natural history of the commoner neoplasms will be discussed.

Detailed methods will be described for the use of x-rays and radium, and the indications for surgery, where this method of treatment has been proved superior to radiotherapy.

Course No. 22:   Thursday, 8:30–10 A.M.

Roentgen Diagnosis and Treatment of Neoplastic Disease in Childhood

EDWARD B. D. NEUHAUSER, M.D.

The Children's and The Infants' Hospitals
and
The Department of Radiology, Harvard Medical School
Boston, Mass.

Cancer in childhood is considerably more important than is generally conceded.   It is one of the more important causes of death in infancy and childhood.   Although children are susceptible to nearly all neoplastic processes that are seen in adults, this course will be limited chiefly to a discussion of tumors that are peculiar to or chiefly seen in childhood. Particular attention will be devoted to roentgen diagnosis, and a brief résumé of methods of treatment carried out at The Children's Hospital of Boston will be presented.

Course No. 23:   Thursday, 8:30–10 A.M.

Application of Fundamental Principles of Radiation Therapy

SIMEON T. CANTRIL, M.D.

Tumor Institute of Swedish Hospital
Seattle, Wash.

(Continued from Wednesday.   See Course No. 18)

Course No. 24:   Friday, 8:30–10 A.M.

Roentgenologic Diagnosis of Diseases of the Colon

DAVID G. PUGH, M.D.

Mayo Clinic
Rochester, Minn.

The conduct of the examination of the large intestine will be described.   Emphasis will be placed upon the technic of examining the large intestine and considerable time will be devoted to double-contrast studies and the indications for examinations of that type.   The criteria for the diagnosis of the lesions more frequently encountered will be discussed.

Course No. 25:   Friday, 8:30–10 A.M.

Tumor Pathology as Applied to Irradiation Therapy

JOHN W. BUDD, M.D.

Los Angeles Tumor Institute
and
JUSTIN J. STEIN, M.D.

College of Medical Evangelists
Los Angeles, Calif.

1.   Lantern slide demonstration of the histopathology of the more common types of cancer with special reference to microscopic structure of early cancer.

2.   Discussion of types of therapy and response to treatment in relationship to the structure of tumors and stage of disease.

Course No. 26:   Friday, 8:30–10 A.M.

Clinical Use of Radioactive Isotopes

B. V. A. LOW-BEER, M.D.
EARL R. MILLER, M.D.

University of California
San Francisco, Calif.

In this series Dr. Low-Beer will discuss the use of radiophosphorus, radiosodium, radiostrontium, radiomanganese, and radiozinc.

Dr. Miller will discuss radioiodine in application to clinical medicine.

Emphasis will be placed on the use of radioactive isotopes as a diagnostic means in clinical medicine. The therapeutic values of radioactive isotopes will also be enumerated and shortly discussed.   The rapidly spreading use of radioactive isotopes in clinical medicine places the field of radiology in even a more forward field than in the past.   The radiologist, being familiar with the problems of radiation, radiation dosage, and radiation protection, has to take the leading part in this new clinical field. It is the intention of the lecturers to analyze the problem from this point of view.

Course No. 27:   Friday, 8:30–10 A.M.

Variations of the Normal Chest in Infancy and Childhood

EDWARD B. D. NEUHAUSER, M.D.

The Children's and The Infants' Hospitals
and
The Department of Radiology, Harvard Medical School

There is no more difficult field of roentgen inter-

pretation than that of slight or minor variations from the normal picture in infancy and childhood. A discussion of the normal chest with normal variants will be presented, and a descriptive résumé of conditions producing slight variations from this normal picture will be given. This will include some abnormalities of the heart and mediastinal shadows with particular attention to the thymus, esophagus, and trachea. No attempt will be made to cover all diseases of the lungs, but particular attention will be given to interstitial pneumonia, bronchial plugging, and tuberculosis.

Course No. 28:   Friday, 8:30–10 A.M.

Treatment of Cancer of the Oral Cavity

J. A. DEL REGATO, M.D.

Ellis Fischel State Cancer Hospital
Columbia, Mo.

The gross pathology of tumors of the oral cavity, with particular reference to their metastatic properties, will be discussed. The indications of external roentgen therapy, peroral roentgen therapy, interstitial curie therapy, and surgery will be discussed for the different anatomic locations. The problem of metastases will be analyzed separately for each one of these locations, and the indications of treatment for these metastases, as well as a discussion of prophylactic neck dissections, will be included.

SIXTH INTERNATIONAL CONGRESS OF RADIOLOGY

Approval has been given by the Executive Committee for the Sixth International Congress of Radiology to be held in London in the summer of 1950. The officers for the Congress are:

President: Dr. Ralston Paterson
President Emeritus: Dr. A. E. Barclay
Vice-Presidents: Dr. S. Cochrane Shanks, Prof. B. W. Windeyer, Prof. W. V. Mayneord, Dr. F. Gordon Spear.
Treasurer: Dr. H. Graham Hodgson.
Secretary-General: Dr. J. W. McLaren.

Full details will be published as soon as possible. An office for the Congress has been established at 45 Lincoln's Inn Fields, London, W.C. 2.

THE CHICAGO ROENTGEN SOCIETY

The recently elected officers of the Chicago Roentgen Society are Dr. Fay H. Squire, President; Dr. T. J. Wachowski, Vice-President; Dr. John Gilmore, 720 N. Michigan Ave., Chicago 11, Secretary-Treasurer.

DR. LEON J. MENVILLE

A total of twenty-nine years of service to the medical teaching profession recently came to a close for Dr. Leon J. Menville, Professor of Radiology in the Tulane University School of Medicine, and former editor of RADIOLOGY. Dr. Menville retired from his active teaching duties June 30, but continues his active practice of radiology in New Orleans.

Dr. Menville was appointed to the Tulane faculty in 1918 as clinical assistant in medicine and has served that institution continuously. He was made Professor of Radiology in 1934. On July 1, 1948, he was honored by the title Professor Emeritus.

In Memoriam

EDWIN S. FLARSHEIM

1894–1948

It is with sincere regret that we report the death on June 29 of Edwin S. Flarsheim, one of the founders of The Liebel-Flarsheim Company, Cincinnati.

Mr. Flarsheim was born in Louisville, Ky., on Jan. 7, 1894. He attended Manual Training High School in Louisville and was graduated as top-honor engineering student from Rose Polytechnic

Edwin S. Flarsheim

Institute. In 1917 he joined with Mr. G. H. Liebel to form The Liebel-Flarsheim Company.

Mr. Flarsheim's contributions to the electro-medical field will serve as a lasting tribute to his memory. To him belongs the credit for the development of much of the x-ray, electrosurgical, and electromedical equipment made by The Liebel-Flarsheim Company and used by doctors, surgeons, and hospitals in all parts of the world.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE RADIOLOGY OF BONES AND JOINTS. BY JAMES F. BRAILSFORD, M.D., PH.D., F.R.C.P., F.I.C.S., Hunterian Professor, Royal College of Surgeons, England, 1934–5, 1943–4; Founder and First President of The British Association of Radiologists (now the Faculty of Radiologists); Director of Radiological Studies in Living Anatomy, the University of Birmingham; Honorary Radiologist to the Queen Elizabeth Hospital, Birmingham, the Royal Cripples' Hospital, and the Warwick-

shire Orthopaedic Hospital; Radiologist to St. Chad's Hospital, the City of Birmingham Infant Welfare Centres and the Military Hospital, Hollymoor, Birmingham; Consulting Radiologist to the City of Birmingham Hospitals, etc. Awarded the Robert Jones Gold Medal and Prize of the British Orthopaedic Association, 1927, the Roentgen Prize, 1936. A volume of 760 pages, with 615 illustrations. Published by J. & A. Churchill Ltd., London. 4th ed., 1948. Price 63s.

THE MECHANISM OF ABDOMINAL PAIN. By V. J. KINSELLA, M.B., CH.M. (Syd.), F.R.C.S. (Eng.), F.R.A.C.S., Hon. Surgeon, St. Vincent's Hospital, Sydney; Hon. Surgeon, Hornsby Hospital. A volume of 230 pages, with 17 illustrations. Published by Angus & Robertson Ltd., Sydney, Australia, 1948.

CHIRURGIE MODERNE DE LA HANCHE. APPORT DE LA RADIOGRAPHIE DE PROFIL. By RENÉ CHARRY, Ancien Chef de Clinique chirurgicale a la Faculté de Toulouse, Membre de la Société internationale de chirurgie orthopédique et de traumatologie. Preface by Professor PAUL MATHIEU. A volume of 326 pages, with 512 illustrations. Published by G. Doin & Cie, 8, Place de l'Odéon, Paris VI°, 1948.

Book Reviews

THE SKULL, SINUSES AND MASTOIDS. A HANDBOOK OF ROENTGEN DIAGNOSIS. By BARTON R. YOUNG, M.D., Professor of Radiology, Temple University Medical School. A volume of 328 pages, with 141 plates. Published by The Year Book Publishers, Chicago, 1948. Price $6.50.

This is the sixth and last of the series of Handbooks of Roentgen Diagnosis published by the Year Book Publishers. The plan of presentation is essentially the same as in the earlier volumes of the series—a brief description of the clinical and roentgenologic aspects of each condition, followed by illustrative roentgenograms. The quality of the cuts is excellent and they have been so arranged that they appear for the most part on the page opposite the descriptive text, a particularly pleasing feature.

In accordance with the title, the text is presented in three parts. Part I deals with the normal and pathological aspects of the skull, including a brief account of the technical aspects of positioning for the production of satisfactory roentgenograms. In Part II the normal anatomy of the sinuses, their developmental variations and the disease processes affecting them are discussed. Part III deals with the mastoids in similar fashion. A general bibliography is appended.

The descriptive matter is brief, as befits a handbook, but is well presented and reflects the teaching experience of the author. Those who desire a concise and reliable review of the subject will find this book of real value. It is a worthy successor to its predecessors.

TECHNIQUE D'IRRADIATION DES TUMEURS MALIGNES. ROENTGENTHERAPIE-CURIETHERAPIE. By CH. GUILBERT, Ancien chef de service radiologique à l'Hôpital Lariboisière. A volume of 300 pages, with 45 figures. Published by G. Doin & Cie, Paris VI°, 1947. Price 650 fr.

In this rather small book the author, who is head of the radiologic service at Lariboisière Hospital, Paris, attempts to set forth the fundamental principles on which the treatment of malignant tumors with roentgen rays and radium is based, including the variations in technic employed and advocated by various well known radiologists, chiefly those from continental Europe. The book, which is printed on rather inferior paper (because paper of better grade was not available), is divided into 26 short chapters.

While it is obviously impossible to cover the subject matter adequately in a book of this size, the author has struggled valiantly to provide students with a general summary that will help them to learn the basic facts. This was not, however, a work to appeal to the seasoned radiologist.

CANCER. TOME I. HEREDITE—HORMONES—SUBSTANCES CANCÉRIGÈNES. By DOCTEUR J. MAISIN, Professeur a l'Université de Louvain, Directeur de l'Institut du Cancer à Louvain. A volume of 248 pages. Published by Casterman, Tournai-Paris, 1948. Price 84 francs.

This book was written primarily for scientists who are not specialists in cancer research. Volume I presents an excellent review of the modern theories of the role of heredity, hormones, and the carcinogenic substances in the etiology of cancer. Volume II, which will be concerned with radiations, viruses, and environment is to appear in the near future.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer,* Donald S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary,* Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary,* Harold Dabney Kerr, M.D., Iowa City, Iowa.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary,* Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary,* U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Courtney S. Stickley, M.D., Bell Bldg., Montgomery. Next meeting with State Medical Association.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary,* Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary,* Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary,* Moris Horwitz, M.D., 2009 Wilshire Blvd., Los Angeles 5. Meets second Wednesday of each month at County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary,* Charles E. Grayson, M.D., Medico-Dental Bldg., Sacramento 14. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary,* L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary,* R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary,* Ivan J. Miller, M.D., 49 Fourth St. Meets monthly on the third Thursday at 7:45 P.M., January to June at Lane Hall, Stanford University Hospital, and July to December at Langley Porter Clinic, University of California Hospital.

Colorado

DENVER RADIOLOGICAL CLUB. *Secretary,* Mark S. Donovan, M.D., 306 Majestic Bldg., Denver 2. Meets third Friday of each month, at the Colorado School of Medicine and Hospitals.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary,* Robert M. Lowman, M.D., Grace-New Haven Hospital, Grace Unit, New Haven. Meetings bimonthly, second Thursday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary,* Alfred A. J. Den, M.D., 1801 K St., N. W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* J. A. Beals, M.D., St. Luke's Hospital, Jacksonville. Meets in April and in November.

Georgia

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Robert Drane, M.D., De Renne Apartments, Savannah. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary,* T. J. Wachowski, M.D., 310 Ellis Ave., Wheaton. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April, at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary,* John H. Gilmore, M.D., 720 N. Michigan Ave., Chicago 11.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer,* William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary,* Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

LOUISVILLE RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Everett L. Pirkey, Louisville General Hospital, Louisville 2. Meets second Friday of each month at Louisville General Hospital.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City, 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ralph C. Moore, M.D., Nebraska Methodist Hospital, Omaha 3. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston. Meets monthly on third Friday at Boston Medical Library.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary-Treasurer*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Raphael Pomeranz, M.D., 31 Lincoln Park, Newark 2. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Abraham H. Levy, M.D., 1354 Carroll St., Bklyn. 13. Meets fourth Tuesday of every month, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary-Treasurer*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings in January, May, and October.

LONG ISLAND RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Wm. Snow, M.D., 941 Park Ave., New York 28.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary*, Murray P. George, M.D., 260 Crittenden Blvd. Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary-Treasurer*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 1338 Second St., N., Fargo.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Carroll Dundon, M.D., 2065 Adelbert Road, Cleveland 6. Next meeting at annual meeting of the State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel, Columbus.

CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Eugene L. Saenger, M.D., 735 Doctors Bldg., Cincinnati 2. Meets last Monday, September to May.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George L. Sackett, M.D., 10515 Carnegie Ave., Cleveland 6. Meetings at 6:30 P.M. on fourth Monday, October to April, inclusive.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wm. Y. Burton, M.D., 242 Medical Arts Bldg., Portland 5. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Arthur Finkelstein, M.D., Graduate Hospital, Philadelphia. Meets first Thursday of each month at 8:00 P.M., from October to May in Thomson Hall, College of Physicians, 21 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, R. P. Meader, M.D., 4002 Jenkins Arcade, Pittsburgh 22. Meets second Wednesday of each month at 6:30 P.M., October to June.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frére, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meetings on third Monday of each month in Dallas in the odd months and in Fort Worth in the even months.

HOUSTON X-RAY CLUB. *Secretary*, Curtis H. Burge, M.D., 3020 San Jacinto, Houston 4. Meetings fourth Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth 4. Next meeting Jan. 7–8, 1949.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. Lowry Allen, M.D., Judge Bldg., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE. *Secretary*, Henry H. Lerner, M.D. Meets first and third Thursdays, September to June, inclusive, at Salt Lake County General Hospital.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Homer V. Hartzell, M.D., 310 Stimson Bldg., Seattle 1. Meetings fourth Monday October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, A. Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, S. R. Beatty, M.D., 185 Hazel St., Oshkosh. Two-day meeting in May and one day with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3524, Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D., 2100 Marlowe Ave., Montreal 28, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Cerebral Angiography. Philip J. Hodes, Charles R. Perryman, and Richard H. Chamberlain. Am. J. Roentgenol. **58**: 543–582, November 1947.

This is a well written and complete discussion of cerebral angiography, a subject which is gaining prominence. The advantages, disadvantages, indications, and contraindications are taken up, and the use of thorotrast is endorsed. Case presentations illustrate practically every condition which can be demonstrated by the procedure. Where indicated, reproductions of air studies are also shown. The illustrations are well reproduced and are accompanied by diagrams which make it possible for one to see the lesion on the angiogram even without experience in interpreting this type of film.

One flaw noted is that the authors completely ignore the question of the late effects of the radioactivity of the thorotrast. It would seem to be fairly well demonstrated, in view of the research done in connection with the Manhattan Project, that any amount of thorium would be too much.   ZAC F. ENDRESS, M.D.

Premature Closure of the Cranial Sutures. Donald R. Simmons and William T. Peyton. J. Pediat. **31**: 528–547, November 1947.

Cranial stenosis is a relatively rare anomaly in which the sutures of the skull close prematurely, causing compression of the intracranial contents. The authors describe the various forms of this condition and submit a classification which they feel may remove some of the confusion which now exists.

A. Complete, early, premature synostosis of the cranial sutures (oxycephaly, turricephaly, Turmschädel)
    1. Oxycephaly with facial deformity
    2. Craniofacial dysostosis of Crouzon
    3. Acrocephalosyndactylism
    4. Delayed oxycephaly (onset after birth)
B. Incomplete early synostosis of the cranial sutures
    1. Scaphocephaly: premature closure of the sagittal suture
    2. Brachycephaly: premature closure of the coronal suture or lambdoidal suture
    3. Plagiocephaly: asymmetrical premature closure of the sutures
    4. Mixed
C. Late premature synostosis of the cranial sutures after the skull has reached or nearly reached adult size so that no deformities and no symptoms result. (Usually up to three years of age. Not to be considered pathological.)

The history, possible etiology, diagnosis, and treatment of craniostenosis are discussed and stress is laid upon the importance of diagnosis prior to the time when irreparable damage has been done to the brain by a non-yielding skull. In all cases of premature synostosis of the cranial sutures, their obliteration can be most readily demonstrated roentgenologically, and this is essential for a diagnosis. The bone immediately adjacent to the obliterated suture shows increased density and is of greater thickness than elsewhere in the skull. Roentgenograms also reveal the characteristic shape of the skull, which may be overlooked on physical examination. The orbits may be shallow, and the orbital roofs may assume a nearly vertical position. The middle fossa may be abnormally deep, and the auditory meati may be in a low position. The superior orbital fissure is short and narrow. The frontal sinuses are small. The skull is usually, though not invariably, thinned. In scaphocephaly there is a platybasia with an increase in the basilar angle. In oxycephaly the basilar angle is decreased, and there is a basilar kyphosis.

Careful study of the roentgenograms is especially important if surgical intervention is contemplated, since the procedure will depend in large part upon which sutures are synostosed.

Frequently syndactylism of either the hands or feet is associated with craniostenosis. Except for deformity of the skull itself, the most common complaint is related to the eyes. Exophthalmos from a shallow orbit, external strabismus, and loss of vision due to optic atrophy because of the skull deformity causing compression of the optic nerve are additional findings. The mental status of these patients is a matter of controversy, but so many cases of associated mental deficiency have been recorded that there seems little doubt that there is a relationship between the two conditions. Differentiation of craniostenosis from microcephaly is important. In most cases this should be possible at an early age.

The large majority of cases of craniostenosis are not of severe degree, and in these no treatment is required. The most important indication for surgical intervention is mental retardation. At the first evidence of such retardation craniectomy should be undertaken, for, while it is impossible to repair brain damage which has already occurred, its further progress can be prevented. Failing vision is also an important surgical indication.

One reason for the unsatisfactory results of operations for craniostenosis is that bone quickly grows across the craniectomy defect. A method using tantalum foil to prevent such bone regeneration is presented.   JOSEPH C. FURNARI, M.D.

The Sialogram in the Diagnosis of Swelling About the Salivary Glands. Milford D. Schulz and David Weisberger. S. Clin. North America **27**: 1156–1161, October 1947.

The authors report 125 cases of salivary gland swellings in which x-ray visualization of the duct systems was attempted. In all but 15 the procedure was successful.

Injection of 1.5 to 2 c.c. of warm iodized oil into the parotid ducts and slightly less into the submaxillary ducts was accomplished with a 2-c.c. syringe and a No. 24 needle with a rounded point. Slitting the end of the ampulla was sometimes necessary in submaxillary catheterization. The procedure was never harmful and only occasionally painful. Films of the parotid gland were secured in lateral, anteroposterior, and frontosubmental projections; of the submaxillary, in the lateral and frontosubmental projections.

Encapsulated expanding tumors within the glands, if large or favorably placed, could be demonstrated, but small and peripheral tumors could not be recognized. The recognition of malignant infiltrating tumors was disappointing, although other writers have reported

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characteristic findings. Extrinsic tumors could be shown by displacement of an otherwise normal gland or duct. Swellings due to Mikulicz's disease or sarcoid showed normal sialographic findings.

Swellings due to inflammation within the gland or duct or due to obstruction by stricture or stone produced almost constant characteristic findings. In chronic parotitis the picture was somewhat reminiscent of what is seen in bronchiectasis. The acini seemed to have coalesced, and many small sharply defined cavities were seen throughout the gland. In chronic infection, the small cavities may coalesce, and the duct system appears widened and irregular. In swellings due to obstructing stones, the calculi can be shown. Multiple strictures of Stensen's duct give the characteristic "sausage" appearance. CHARLES B. COBERN, M.D.

Use of Air Injections into Tenon's Capsule for Localization of Orbital Foreign Bodies. Benjamin Friedman. Arch. Ophth. 38: 660–664, November 1947.

Injection of air into Tenon's capsule has been found of considerable value in the exact localization of orbital foreign bodies. The air outlines the contour of the globe, and this delineation provides a basis for judging the relative position of the suspected foreign body. If the foreign body is extraocular, it will be separated from the globe by the intervening air pocket. Hodes and Scheie (Arch. Ophth. 35: 13, 1946. Abst. in Radiology 47: 626, 1946) used oxygen instead of air and found that most of the gas was absorbed within eight hours.

The best roentgenograms are obtained when the forehead, nose, and malar bone of the patient rest on the cassette. The horizontal plane of the skull is perpendicular to the table, and the sagittal plane makes an angle of 52 degrees with the table. The tube is tilted toward the feet until the central ray makes an angle of 20 degrees with the horizontal plane of the skull. The beam is centered over the orbit nearest the film. Stereoscopic films are taken.

The cassettes must be scrupulously clean; if not, they will yield artefacts which may be indistinguishable from shadows of the true foreign bodies. Cardboard film covers may be employed, but one loses thereby the advantage of the intensifying screen which is built into the cassette. Higher roentgen energy is required without the intensifying screen; the amount approximates the epilating dose and care must be taken to avoid overexposure.

Bone-free exposures of the anterior ocular segment may be made on dental film. The exophthalmic state of the eye will give opportunity for roentgen examination of more of the anterior segment than is usually projected in ordinary circumstances. It might be justifiable to inject air into Tenon's space for the sole purpose of bringing the cornea forward when bone-free films are required.

The clinical observations must always be correlated with the roentgenographic findings. If its shadow falls external to the outlines of the globe, the foreign body must be outside the eye. Positive findings are less conclusive. The shadow of the foreign body may be superimposed on the shadow of the globe; yet the foreign body itself may lie outside the eye. The foreign body must lie outside the nearest tangential rays in order to register external to the outline of the globe. It may theoretically be necessary to make exposures from many

angles in order to prove definitely that the foreign body is inside the eye; actually, however, this may be avoided by the use of stereoscopic films. In most instances the depth of the foreign body may be gauged with fair accuracy with the stereoscope. The films should be drawn close to the observer's eyes in order to obtain the optimum size of the images.

Injection of air is contraindicated in the presence of a large, recent perforation or in cases in which immediate operation is contemplated.

Roentgenograms from 4 cases are reproduced.

Investigation of the Different Dense Substances of the Teeth by X-Rays. E. Brandenberger and H. R. Schinz. Schweiz. med. Wchnschr. 77: 1147–1149, Nov. 1, 1947.

In human and animal tooth sections roentgenography shows two substances of different density: the enamel, having the greater absorption, and the dentine, cement, and tooth stones, having the lesser absorption. The degree of difference approximates that observed between bone and amorphous calcifications. Diffraction studies of the inorganic portion of the tooth show a crystalline structure of the apatite series, usually similar to hydroxylapatite or a closely related pattern. The density differences are due to variations in apatite content and are related to the quality and size of the apatite crystals. The individual crystals of the enamel are larger and more perfect, as contrasted to those of the dentine, and more closely approximate those found in bone. These studies clearly demonstrate the importance of crystalline apatite as a medium for hardness in the supporting structures of man and vertebrate animals; the fact is, it is the only substance whose presence leads to hardness in the tissues. LEWIS G. JACOBS, M.D.

THE CHEST

Tuberculosis Case-Finding Survey of the Total Population of Reykjavik, Iceland, in 1945. Sigurdur Sigurdsson and Oli P. Hjaltested. Pub. Health Rep. 62: 1593–1607, Nov. 7, 1947.

This is another report of the tuberculosis survey conducted by the Health Center in Reykjavik, Iceland, during the first four months of 1945, including almost 99 per cent of the 46,000 inhabitants of the city. (See also Petersen, G. Fr.: Acta radiol. 28: 400, 1947. Abst. in Radiology 51: 276, 1948.)

Children and young people from the age of one to twenty years were first given the Volmer patch test or the Mantoux test, and all those reacting positively were examined radiographically. The initial tests were made on 11,605 children, and the percentage of positive reactors ranged from about 1 per cent for those a year old to 44 per cent at the ages of nineteen and twenty. The population over twenty years of age was surveyed by radiographic examination alone. The photoroentgen method, with 4-× 5-inch film, was employed. All the films were read by two groups of radiologists. Positive and questionable cases were re-examined, usually with standard size films.

Of all those radiographed, 1,329 were called back for re-examination; 808 persons were found to have tuberculosis which had been unknown to the Health Center previously. Of this number, 71 (1.6 per 1,000

subjects) had active tuberculosis; 60 per cent of these were in the age group fifteen to thirty years and, what is more surprising, 8.4 per cent were over sixty.

Seventy-five of the cases discovered (1.7 per 1,000 subjects) were of indeterminate activity. It was felt that most of these would eventually fall into the inactive disease classification, though all are being studied further. In a year of observation, only 2 cases of this group had become active.

The remaining 662 of the 808 cases (15.2 per 1,000 subjects) showed fibrotic or calcified tuberculous changes considered inactive.

The survey also revealed 14 patients with bronchiectasis, 6 with atypical pneumonia, 11 with high-seated calcified hydatid cysts of the liver with secondary pulmonary changes, 4 with pulmonary carcinoma, and 4 with situs inversus.

It is concluded that the photoroentgen method is practical for survey purposes. Its relative accuracy as compared to examination with standard size films is not discussed beyond the statement that in cases re-examined the latter generally revealed striking uniformity with the photoroentgenograms. Some inclination to over-read the photoroentgenograms was apparent.   BERNARD S. KALAYJIAN, M.D.

Control of Tuberculosis Among College Students in Texas. J. Edward Johnson. Texas State J. Med. 43: 424–428, November 1947.

The number of colleges in the United States known to have tuberculosis control programs increased from 6 in 1931 to 362 in 1946. Tabulations by the Tuberculosis Committee of the American Student Health Association show that 12 to 18 times as many cases of active tuberculosis are found by schools conducting control programs as by those who make no special search for the disease. While the present paper has to do primarily with the situation in Texas, its discussion of control programs is applicable to colleges in general.

The essential object of a college control program should be to locate, isolate, and exclude active cases of tuberculosis. Specifically, the minimum requirements are admission certification of a recent negative intradermal test or, if such a test was positive, a recent negative chest roentgenogram; an annual photofluorographic survey, which may be arranged through the State Health Department or Tuberculosis Association; and, finally, chest roentgenograms at six-month intervals of students, faculty, and staff members with known inactive lesions. In schools with average health facilities this program should be extended to the faculty and all non-student personnel.

The author emphasizes strongly the value of the tuberculin skin test and quotes the Tuberculosis Committee of the Student Health Association as advising that it is safe to limit roentgenography to positive reactors. Only by tuberculin testing can a case be discovered in the "pre-roentgen" stage, and only by supervision of positive reactors can new contact infections be avoided. Over-dependence upon photofluorography to the neglect of other control agencies is to be deprecated.

A photofluorographic survey of 16,320 students at the University of Texas located 72 cases of significant disease, a rate of 0.4 per cent. A survey of 1,005 faculty and staff members and other employees provided 19 additional cases, or a rate of 1.8 per cent. Since the latter group shows a rate 4.5 times as high as the

student body, the need to include them in control supervision is obvious.

Questions and problems raised by the Texas survey are discussed.   GLENN F. MILLER, M.D.

The 1946 Erie County Chest X-Ray Survey. Ralph D. Bacon. Pennsylvania M. J. 51: 141–147, November 1947.

A total of 101,462 persons living in Erie County, Pennsylvania, all over the age of fifteen, had microfilm chest examinations within a three-month period. This was made possible by the combined efforts of the Tuberculosis Society, the Medical Society, and numerous service organizations. A committee was formed to advertise the project to the general public, and the medical profession was acquainted with the purpose of the work by announcements at medical meetings, by items in the bulletin of the county medical society, and finally by a personal letter to each physician.

The films were read by six specialists. One man, working nearly full time, read 76 per cent of the total number. He was able to read as many as 2,500 a day and maintain accuracy. The results were marked on cards suitable for statistical analysis.

Of the 101,462 microfilms, 1,455 were not readable and a retake was recommended. The final corrected total was 100,539, of which 90,868 (90.6 per cent) were negative; 4,737 (4.7 per cent) showed healed primary lesions; 691 (0.7 per cent) were classified as showing pleurisy, 117 (0.1 per cent) silicosis, and 1,332 (1.9 per cent) evidence of cardiac pathology or aortic lesions. In 1,211 (1.2 per cent), there was evidence of tuberculosis of the reinfection adult type.

The actual cost of the survey, not counting the enormous amount of free help, was $88,000, or about 87 cents per person, but the follow-up costs for one year are estimated at $15,000, bringing the total for a year to over $100,000.

Although the urgency of appropriate management of those afflicted with tuberculosis was well advertised to both the general public and physicians, only 295, or 25 per cent of the positive cases, have thus far been properly classified and the necessary treatment instituted. In 90 of these cases the final decision of the physician was based on clinical evidence; 140 were studied by further chest roentgenography, and in 55 cases sputum tests were done. In 51 cases tuberculosis was excluded. Of the 244 remaining, 167 (68 per cent) were classified as minimal, 60 (25 per cent) as moderately advanced, 8 as far advanced; 9 were designated as "miscellaneous." Forty cases (16.4 per cent) were considered active.   JOSEPH T. DANZER, M.D.

Immigration Tuberculosis. J. D. Adamson and J. N. Edmison. Canad. M. A. J. 57: 432–434, November 1947.

The author calls attention to the danger of importation of tuberculosis into Canada from countries devastated by the war. Tuberculosis among immigrants to Canada could prove to be a serious public health problem unless appropriate preventive measures are adopted. A survey of 2,876 Polish soldiers who entered the country without preliminary roentgenograms showed 3 per cent to have pulmonary or pleural tuberculosis. The authors classified the cases, and stated that 1.2 per cent of the original group would require sanatorium treatment. It has been recommended by the Canadian Tuberculosis Association that all pro-

spective immigrants have a chest roentgenogram for screening purposes before embarkation for Canada The authors believe that all recent immigrants should also have an annual examination by provincial tuberculosis organizations for two or three years.

FREDERICK R. GILMORE, M.D.

Miliary Tuberculosis Treated with Streptomycin: Report of Case with Necropsy Findings. Frederick H. Taylor and George G. Snively. Am. Rev. Tuberc. 56: 438–441, November 1947.

A case of miliary tuberculosis is reported which showed striking improvement under streptomycin therapy, though the patient eventually died as a result of concomitant involvement of the central nervous system.

An admission film of the chest showed diffuse submiliary nodulation of both lung fields. A progress film taken after three months of streptomycin therapy revealed a marked clearing of the miliary nodules. At postmortem examination, occasional large tubercles with caseous centers were found in the lung, but elsewhere in the lung there was evidence of a regressing process with considerable connective tissue in the regions of tubercle formation. A marked and active fibroblastic response was noted.   L. W. PAUL, M.D.

Bronchial Lymph Node Perforation in Primary Tuberculosis of Infancy: Discussion of 8 Cases. T. Valledor, J. C. Mérida, and A. Guernica. Rev. cubana pediat. 19: 635–665, November 1947.

Eight cases are reported in which a tuberculous lymph node had perforated into the bronchus. The patients were all children, from five months to ten years of age. Six were under one year; 1 was two years old, and 1 ten years. Five were white and 3 Negroes. Four were boys, 4 girls. In 4 cases the diagnosis of fistula was confirmed by postmortem examination; in 2 by x-ray examination and bronchoscopy; in the other 2 the diagnosis was only clinical. In 7 cases there was a family history of tuberculosis; in one case the source of infection could not be detected. In all the cases the initial manifestations were fever and an increase in clinical symptoms. In 2 cases there was a history of whooping cough a few months earlier; acute tonsillitis, grippe, and common colds preceded perforation in 3 cases.   JAMES T. CASE, M.D.

Some Nontuberculous Diseases of the Lungs. Robert Charr. M. Clin. North America 31: 1475–1492, November 1947.

This is a rather general article on non-tuberculous diseases of the lungs, including bronchogenic carcinoma, pneumoconiosis, and the fungous diseases (coccidioidomycosis, histoplasmosis, actinomycosis). The incidence, etiology, symptoms, and treatment of each disease are discussed, and characteristic roentgenograms are reproduced.

Multiple Pulmonary Calcifications. Edgar Alsop Riley. Am. Rev. Tuberc. 56: 423–437, November 1947.

The literature on the subject of mulitiple pulmonary calcifications is reviewed. It has become evident that the concept of tuberculosis as the only disease producing pulmonary and hilar node calcification may need revision and that there are many conditions other than

tuberculosis which may produce a miliary appearance on x-ray examination. The author's discussion is based upon 47 cases of multiple pulmonary calcification studied at Fitzsimons General Hospital. These are divided into four groups. Group A consisted of 5 cases of pulmonary tuberculosis of approximately twenty years duration. Group B consisted of 3 cases in which only chest films were available, all showing multiple pulmonary calcifications. Group C consisted of 11 cases with x-ray films showing calcification for which incomplete clinical data were available. Group D consisted of 26 cases with x-ray films and complete clinical data. An additional group was made up of 2 cases which came to autopsy, both showing multiple pulmonary calcification. It was not possible to determine the etiologic agents except in the first group, in which tuberculosis was definitely established as the cause for the calcification. No attempt was made to determine the incidence of histoplasmin sensitivity in these patients.

Regardless of etiology it is assumed that these lesions almost always result from a combination of hematogenous and bronchial dissemination. Two aspects of the chest films are stressed. In almost all cases of the hematogenous type, the mid and lower lung fields were predominantly involved. In the bronchial type, the lesions were almost always confined to a single lobe or to the basal areas. Until the opportunity is presented to watch such lesions from incipiency to final calcification, and to recover the etiologic agent during the active phase, all discussion as to the etiologic factor and pathogenesis is purely speculative.

L. W. PAUL, M.D.

Pathogenesis of Bronchiectasis. T. B. Mallory. New England J. Med. 237: 795–798, Nov. 27, 1947.

In considering the pathogenesis of bronchiectasis, four points stand out: it is rarely a diffuse disease; it is not usually a progressive disease; it is rarely an isolated finding in an otherwise normal lung; it is characteristically a disease of youth.

If bronchitis were a cause of bronchiectasis, one would expect to find it in the aged rather than in the young. No specific organism has been found as a causative agent. In an investigation of lobectomy specimens there was no definite parallelism between the severity of infection and the degree of bronchial dilatation.

No definite congenital defect has been demonstrated to be a cause of bronchiectasis.

Bronchial stenosis does not appear to induce dilatation of the distal bronchial branches. It may be considered a contributory cause, but most bronchiectatic lungs show no indication of narrowing of the bronchial tree proximal to the areas of dilatation.

Atelectasis occurs frequently in the young age groups and bronchograms will show dilated bronchi throughout the atelectatic areas. If early drainage is accomplished, the bronchi will return to normal, but more frequently the ectasia is already irreversible when first discovered. It is believed that the excessive negative intrathoracic pressure in atelectasis is responsible for the dilatation of the bronchi.

In bronchiectasis there is usually a history of pneumonia, influenza, tonsillectomy, or aspiration of a foreign body. All these are believed to be in some way connected with the development of the disease.

Of all the possible causes of bronchiectasis, no one

seems to be exclusively responsible, but a combination of several may constitute the exciting factor. Bronchiectasis appears to be a disease of the pulmonary parenchyma, as well as the bronchial tree. In the lung parenchyma there is a definite reduction in the number of aerated alveoli. It is believed that bronchial infection may cause atelectasis by obstructing the alveoli with mucopurulent secretions. Infants and children are particularly prone to obstructive atelectasis, and in them bronchitis and atelectasis are more frequent than pure pneumonic consolidation. Atelectasis develops in the middle and lower lobes and in the lingula of the left upper lobe, which corresponds to the usual distribution of bronchiectasis.   JOHN B. McANENY, M.D.

Opacities of the Middle Lobe in Bronchiectasis of Children: Their Significance. Jacques Lecoeur and Marc Préault. J. franç. de méd. et chir. thoraciques 1: 415–423, September–October 1947.

A study of 112 children in whom a bronchographic diagnosis of bronchiectasis had been made revealed 28 cases (25 per cent) of middle lobe consolidation. Opacities of the right and left lower lobes were said to be less frequent. There were 10 males and 18 females in the series, all but 3 of whom were between the ages of ten and thirteen years.

Opacities of the middle lobe were seen in the most minimal as well as in the advanced cases of bronchiectasis. In 15 cases, there was bronchiectasis of the middle lobe only, while in 6 cases the right lower lobe bronchi were involved. The 7 remaining cases had associated bronchiectasis of the right and left lower lobes with or without involvement of the lingula division of the left upper lobe.   RODERICK L. TONDREAU, M.D.

Primary Cancer of the Lung. Alton Ochsner, Michael DeBakey, and J. Leonard Dixon. J. A. M. A. 135: 321–327, Oct. 11, 1947.

During the ten-year period, 1935 to 1945, a total of 412 cases of primary lung cancer were observed by the authors. Exploratory thoracotomy was done on 246 patients and, of this group, 147 were subjected to primary resection of the involved lung. In the series in which resection was done there were 141 instances of bronchogenic neoplasm, 2 each of lymphoblastoma and fibrosarcoma, and 1 each of melanoma and neurogenic sarcoma. Most of the patients were men in the fifth, sixth, and seventh decades of life. The ratio of men to women was approximately six to one, and the ratio of white to negro patients was two to one.

It is emphasized that primary cancer of the lung is one of the most frequently encountered malignant neoplasms, and that the most important single factor in the diagnosis of the disease is the consideration of its possible presence. Important diagnostic procedures include roentgenography, bronchography, bronchoscopy, and cytologic examination of sputum or bronchial secretions. Roentgen diagnosis, which was 82.3 per cent accurate in the 147 resected cases, was based mainly upon secondary signs, such as atelectasis, infection, necrosis with abscess formation, and hilar lymph node enlargement. In certain instances of early neoplastic involvement, serial roentgenograms were of particular value when it was difficult to distinguish the shadow of the new growth from that of normal hilar structures. Tomographic examination was sometimes valuable in identifying irregular neoplastic tissue extending into an air-containing abscess cavity. The importance of ob-

taining routine roentgenograms of the chest is exemplified by the fact that 5 of the 147 cases were discovered in this manner, the patients presenting no obvious symptoms.

Bronchoscopy is by far the most accurate diagnostic method, since this procedure frequently not only permits direct visualization of the tumor but also the section of a piece of tissue for microscopic examination. Bronchography is a valuable diagnostic aid in certain instances, especially in the case of peripheral neoplasms beyond the vision of the bronchoscope.

Examination of sputum and bronchial secretions for neoplastic cells is steadily gaining favor and may eventually prove to be the most important diagnostic method available. Demonstration of tumor cells in the pleural fluid is of more prognostic than diagnostic significance.

With relatively few exceptions, pneumonectomy is the treatment of choice. Of the 147 patients in whom this operation was done, 36 (24.5 per cent) died in the hospital and 111 (75.5 per cent) left the hospital alive. Of the latter group 63 (56.8 per cent) have subsequently died and 48 (43.2 per cent) are still alive, one of whom was operated on eleven years ago. The over-all five-year survival rate is approximately 8 per cent.

JOHN F. HOLT, M.D.
(University of Michigan)

Malignant Lymphoma of the Lung and Pulmonary Coccidioidomycosis: A Clinic on Surgical Lesions of the Lung with Consolidation. Edward D. Churchill. S. Clin. North America 27: 1113–1120, October 1947.

The thoracic surgeon usually encounters only those lesions which diminish the volume of the portion of lung involved, as in contracture and scarring following chronic inflammation or the collapse secondary to bronchial obstruction. He seldom sees lesions producing consolidation, for these usually represent stages of pneumonia, infarction, or contusion. A case of malignant lymphoma of the lung and another of pulmonary coccidioidomycosis are reported here as illustrating consolidating lesions for which surgery was undertaken.

The first patient was a 45-year-old housewife complaining of an aching pain in the right shoulder. She was afebrile and did not appear ill. Physical findings were essentially negative except for dullness and diminished breath sounds over much of the right upper lung lobe. Chest films showed an area of density in the upper right lung field, with its lower border at the sixth rib posteriorly. A right thoracotomy was performed, and the right upper lobe was found to be adherent to the chest wall and consolidated in its upper three quarters. The process resembled lobar pneumonia. The middle lobe was fused with the upper and was removed with it. The pathologic diagnosis was malignant lymphoma. Postoperatively the patient was given x-ray therapy, 1,200 r to each of two 15 × 15-cm. portals, one over the anterior chest, the other posterior. After six months she was well, without evidence of recurrence or residual disease.

The lesson to be learned from this case is obvious. If a mass of this size were palpated in the abdomen, exploration would be urged. Masses in the lung cannot be palpated but they can be detected by x-ray, and when careful study leaves reasonable doubt, surgery may be indicated.

The second patient was a 14-year-old boy with an area of increased density lying anterior to the left

hilum and extending anteriorly to the chest wall. This eventually extended to occupy the apical portion of the left upper lobe of the lung. Various diagnostic tests were negative and thoracotomy was done. A consolidated left upper lobe was found, with a large mass at its root and confluent masses extending into the hilum. A lobectomy was carried out. The pathological report stated that the hilar portion of the lobe was occupied by a firm fungating wall of an abscess cavity. Cultures showed the spherules of *Coccidioides* and the diagnosis of pulmonary coccidioidomycosis was established. The organisms were found in the sputum only after operation. The boy's condition steadily deteriorated to a fatal termination.   CHARLES B. COBERN, M.D.

Löffler's Syndrome. Report of a Case in an Infant. George T. O'Byrne. Texas State J. M. **43:** 446–449, November 1947.

Very few cases of Loeffler's syndrome have been reported in infants. The author's patient was first seen in July 1940 at the age of five months, because of a gastro-intestinal allergy manifested by colic and a bloody diarrhea. Attempts to control these symptoms by dietary regulation were only partially successful. On Oct. 8, 1940, the patient was hospitalized because of temperature elevation and a mild diarrhea. A roent-genogram at the time revealed what appeared to be a rather widespread bilateral bronchopneumonia, but no râles, abnormal breath sounds, or percussion changes were present either then or later. Roentgenograms taken at frequent intervals thereafter showed definite changes in the location and intensity of the infiltrations, and repeated leukocyte counts ranged from 1,700 to 7,600, with eosinophils exceeding 30 per cent on eighteen different days and on at least one occasion reaching 50 per cent. The temperature returned to normal on Oct. 29, and the eosinophil count showed a gradual decline. The patient has subsequently been in good health except for occasional attacks of asthma and apparently has no food allergies.

A sternal puncture in this case failed to reveal any increase in the eosinophils in the bone marrow, a finding that is at variance with reports of other cases in which marrow studies were carried out. Serial studies would have been valuable, for had they, too, shown no increase in eosinophils, the extra-marrow origin of these cells in certain conditions, at least in infants, would have been established.

A general discussion of Loeffler's syndrome and its place among the allergies is included.

Case of Progressive Bilateral Bullous Emphysema Complicated by Chest Trauma. Horace Allen Albertson and Charles H. Peterson. Virginia M. Monthly **74:** 522–524, November 1947.

Chest trauma in a patient with "progressive bilateral bullous emphysema" may lead to confusion in the interpretation of the roentgenograms. The case is reported of a man who was admitted to the emergency room of the hospital with injuries to his left chest. For an indefinite length of time he had a cough which he attributed to a "bronchial condition." A diagnosis of fractured ribs and possible traumatic pneumothorax of the left lung was made. A film of the chest taken with a portable machine showed what was interpreted as a bilateral area of pneumothorax immediately adjacent to the mediastinum. Both lungs were somewhat compressed, with scattered areas of infiltration throughout. The left fourth, fifth, and sixth ribs were fractured in the axillary line. The patient's condition grew worse, with increasing shortness of breath and restlessness, and x-ray examination on the sixth hospital day showed an increase in the amount of air on both the right and left sides. There was also a greater compression of the lungs. Shortly thereafter a needle aspiration of the left thorax was done. The needle was inserted just medial to the mid portion of the left scapula. Air was found under pressure and was released. The restlessness was relieved and cyanosis cleared up for a short time. An intercostal trocar was inserted at the site of the aspiration. The patient died fifty minutes later, and an autopsy was performed. The final diagnosis was "progressive bilateral bullous emphysema."

It is believed that if this patient had not entered the hospital as a traumatic case, the x-ray diagnosis would have been obvious. In fact, it was suggested by one physician who saw the films. An attempt to interpret the roentgenograms on the basis of trauma alone, without taking into consideration the history of cough and "bronchial trouble," led to the error in diagnosis.

Infarction of an Entire Pulmonary Lobe with Subsequent Aseptic Softening Causing Sterile Hemopneumothorax. Arnold J. Rawson and John A. Cocke. Am. J. M. Sc. **214:** 520–524, November 1947.

A case is reported in which the entire left lower lobe was infarcted subsequent to long continued passive congestion. Aseptic necrosis occurred, with rupture into the pleura and the production of a hemopneumothorax. Only 5 other such cases have appeared in the literature.   BENJAMIN COPLEMAN, M.D.

Uremic Edema of the Lungs. I. Doniach. Am. J. Roentgenol. **58:** 620–628, November 1947.

In a small percentage of patients in uremia with a high-grade azotemia and left ventricular failure (from hypertension) centrally distributed pulmonary shadows of fairly homogeneous density are demonstrable. In non-fatal cases the shadows may regress. In autopsied cases they are shown to be due to a fibrinous or albuminous intra-alveolar exudate. Some organization and mononuclear cell reaction take place if the condition is of long standing. Similar histologic findings have been seen in the lungs in rheumatic fever.

The etiologic basis is thought to lie in (1) an alteration in capillary permeability, caused by uremia (or by the toxins of rheumatic fever) and (2) increased capillary pressure from the left heart failure. Presumably the falling off of the pressure at the periphery explains why the apices, bases, and extreme periphery remain clear, although the author did not carry his conclusion this far.

Five cases are presented. One showed a marked improvement after eight days of bed rest. Clinically the left heart failure improved, but the blood urea remained unchanged. Photomicrographs show the unusual histologic picture. Roentgenograms from three of the cases are reproduced.   ZAC F. ENDRESS, M.D.

Pleuropulmonary Manifestations of Amebiasis. Hiram T. Langston and Robert T. Fox. Arch. Surg. **55:** 618–623, November 1947.

The authors report six cases of amebiasis with pleuropulmonary involvement. There is no typical

clinical picture, the findings being those of other chest affections. The only finding common to all cases was elevation of the right leaf of the diaphragm. A history of significant dysentery was unusual; only 4 of the patients had served in endemic areas, and amebas were found in the sputum, stool, or aspirated material, in less than half. The amebic abscess can penetrate the diaphragm and rupture into a bronchus without causing either a generalized peritonitis or an empyema.

If a reasonable effort to diagnose a right-sided chest condition fails to be conclusive, amebiasis should be suspected and specific (emetine) therapy started without further delay. A favorable response to this drug confirms the diagnosis of amebiasis, and further courses are the treatment of choice. Aspiration may be used, as required, to relieve pressure symptoms, but early surgical drainage is useless and may delay recovery.

LEWIS G. JACOBS, M.D.

The Interlobar Pleurisies. Marcel Bérard, Pierre Fraisse, and Jean Dumarest. J. franç. de méd. et chir. thoraciques 1: 369–385, September–October 1947.

Thirteen cases of interlobar pleurisy are reported. In 4 cases, the interlobar process represented the remains of diffuse suppuration of the entire thoracic cavity with secondary involvement of a fissure. In the remaining cases, pleural inoculation was apparently due to foci of parenchymatous suppuration situated in the immediate vicinity of a fissure. These foci varied from "the most minimal bronchopneumonic localizations" to frank lung abscess. Thus, the authors divide interlobar effusions into two large groups: (1) those associated with lung abscess and (2) those which are "clinically autonomous" (because the parenchymal foci cannot be detected clinically or radiographically). The latter ranged from simple interlobar effusions to those which had progressed to encysted pyopneumothorax with bronchopleural fistula.

RODERICK L. TONDREAU, M.D.

Esophageal Duplications or Mediastinal Cysts of Enteric Origin. John C. Jones. West. J. Surg. 55: 610–617, November 1947.

Fluid-containing cystic lesions arising along the digestive tract from the mouth to the anus, formerly designated as enterogenous or enteric cysts, are now termed "duplications of the alimentary tract." To the 26 previously reported "esophageal duplications," the author adds two.

The cystic structures are located most commonly in the middle third of the thorax, although they may occur anywhere along the mediastinum; they are variable in size, are always posterior and retropleural, and more commonly occur on the right side. Seventy-five per cent are seen within the first year of life.

The majority of the cysts are lined partially by histologically identifiable gastric or esophageal mucosa. Two layers of muscular wall resembling esophagus are usually found, but never a serosa. A few of these duplications have been found to have no attachment to the esophagus. The cyst fluid resembles gastric juice. In 2 of the cases formerly reported, active peptic ulcer developed in the duplication, perforating the lung and pleura.

Symptoms for the most part are respiratory and may be misdiagnosed as pneumonia, pleural effusion, atelectasis, obstructive emphysema, and empyema.

The diagnosis is uncertain without operation, unless the aspirated fluid obtained from the cyst is acid, but not all cysts contain acid secretions. Lateral and oblique roentgenograms show the cysts to be posterior in contradistinction to dermoids, teratomas, and pericardial cysts, most of which are anterior and cause symptoms much later in life.

The treatment of choice is complete surgical excision as soon as is feasible after the diagnosis of mediastinal tumor or cyst has been made and before bronchopulmonary complications either delay or prevent surgical cure. The majority of duplications of the esophagus, however, are so intimately attached to the esophagus and so frequently have, in places, a common muscular wall, that the two structures are virtually inseparable without injury to the wall of the esophagus. In such cases Ladd and Gross (Surg., Gynec. & Obst. 70: 295, 1940) and others have marsupialized the cyst and depended upon subsequent chemical destruction of the lining mucosa.

The author's patients were children of two months and nineteen months. Roentgenograms in each case showed the presence of a mass, but the diagnosis was made only on microscopic examination, in the first case at autopsy and in the second following surgical excision of the cyst. Death of the younger child was due to bronchopneumonia and is attributed to delay in operative intervention, which is now recognized to have been an error in judgment. The second patient made a full recovery. Reproductions of the roentgenograms and photomicrographs from these cases are included. References are appended.

ERNEST S. KEREKES, M.D.

Medical Progress. Diagnostic Roentgenology: Congenital Lesions of the Heart and Great Vessels: Nephrography. Richard Schatzki. New England J. Med. 237: 738–743, Nov. 13, 1947.

The recent literature on congenital lesions of the heart and great vessels and nephrography is reviewed. A bibliography of 41 references is appended.

A Physiologic Approach to Cardiovascular Roentgenology. Marcy L. Sussman. Minnesota Med. 30: 1041–1048, October 1947.

The author first reviews the fundamental physiology of the heart, then states that the ordinary x-ray examination reveals merely the over-all size of the heart, without enough details as to the individual chambers, which are to be gained only through angiocardiography. Considerable dependence is also placed on the electrokymogram. These preliminary statements serve to indicate the general character of this paper.

The cardiac cycle, as analyzed by the electrokymogram, is dealt with most fully, with stress on such points as timing, bringing out, for example, the fact that in the case of the carotid pulse a slight presystolic peak may be seen corresponding to atrial systole, and that the acute rise of the anacrotic limb corresponds to ventricular ejection. The matter of pressure recordings is not neglected, and it is stated that the catheter may be passed by the radiologist under fluoroscopic control.

The reader is referred to the illustrations in the article for the purpose of drawing his own conclusions. As an example, attention is called to the paragraph on patent ductus arteriosus, and the question is raised as to just how the information set forth there might be utilized by a surgeon who was debating whether or not to ligate

such a ductus. The same criteria apply to the discussions of chronic pulmonary disease and mitral disease. The statement that the mitralized left border is due to the left auricle and not to the pulmonic conus and artery will, undoubtedly, be challenged by some who have done rather extensive postmortem work in relation to this question.   PERCY J. DELANO, M.D.

THE DIGESTIVE SYSTEM

Congenital Atresia of the Esophagus with Tracheoesophageal Fistula. A Report of Six Cases. Joseph A. Perrone, William H. Fleming, and Theodore R. Whitaker. Arch. Otolaryng. 46: 608–616, November 1947.

The 6 cases of congenital atresia of the esophagus presented here, all of which terminated fatally, were seen at Mercy Hospital, Pittsburgh, from 1939 to 1945. The dangers of the use of barium sulfate for diagnostic purposes are exemplified by one case, in which death occurred soon after barium had been permitted to enter the bronchi. Iodized oil should be used in preference to barium, since complications resulting when oil is instilled into the lungs are much less severe than when barium enters these organs.

Radiographic Diagnosis of Perforations of the Upper Gastrointestinal Tract into the Mediastinum and Pleural Cavity. Gordon J. Culver and Stanley B. Clark. Surgery 22: 458–465, September 1947.

Perforation of the esophagus is still attended by a high mortality, especially perforation of the lower part into the pleural cavity. The portion of the esophagus immediately above the diaphragm is closely related to the mediastinal pleura. It is here that the esophageal wall is weakest and may perforate spontaneously under increased pressure, as from coughing or vomiting. Perforation higher up may be due to foreign bodies, instrumentation, or a pre-existing diverticulum, ulcer, or malignant process. The prognosis in these higher perforations is better than in those lower down. If the initial process is of long standing, the accompanying fibrosis may tend to limit the resulting mediastinitis. Also, this region is more accessible for treatment.

The diagnosis of lower esophageal rupture is still too often established only at autopsy. An attempt is made to clarify the radiographic findings to bring about more prompt recognition of this condition. The authors believe that radiographic demonstration of hydropneumothorax immediately following the sudden onset of chest or abdominal pain accompanied by shock and collapse is diagnostic of a perforation of the upper gastro-intestinal tract, either esophagus or stomach, into the pleural cavity. The most common condition to be differentiated is spontaneous pneumothorax. This can be excluded by the absence of an associated pleural effusion. Any doubt is quickly resolved by aspiration from the pleural cavity of saliva or gastric secretions with food. Other writers have mentioned mediastinal widening and emphysema as indicative of esophageal perforation.

The use of radiopaque media as an aid in diagnosis is considered, only to be discouraged. [Why not iodized oil? J. E. W.]

Four cases of esophageal perforation are reported. In two, peptic ulcer was the underlying lesion, and perforation was precipitated by vomiting. In the other two, the perforations were due to instrumentation. The three patients with perforation into the pleural cavity died. The fourth, with a high perforation limited to the mediastinum, survived. Roentgenograms accompany the case histories.

     J. E. WHITELEATHER, M.D.

Section of the Vagus Nerves to the Stomach in the Treatment of Peptic Ulcer. Complications and End Results After Four Years. Lester R. Dragstedt, Paul V. Harper, Jr., E. Bruce Tovee, and Edward R. Woodward. Ann. Surg. 126: 687–699, November 1947.

This paper is one of a series on vagotomy in the treatment of peptic ulcer presented before the American Surgical Association and published in *Annals of Surgery.* It is chosen for abstracting because of the x-ray findings in one of the authors' patients and their significance. Only that phase of the study will be considered here.

Six months after an exclusion operation of the Finsterer-Devine type, with subtotal gastric resection, for a large duodenal ulcer, there was a recurrence of symptoms and a gastrojejunal ulcer was demonstrated roentgenologically. X-ray therapy relieved the symptoms and there was apparent disappearance of the ulcer crater. The symptoms again recurred in six months and again x-ray examination revealed an ulcer crater. A transthoracic supradiaphragmatic section of the vagus nerves was now performed. Recovery was uneventful and the ulcer distress was entirely relieved. X-ray examination three weeks later revealed a definite decrease in the size of the ulcer crater and less than a month after this it had completely disappeared. The patient remained well, and roentgen findings a year and nine months after vagotomy proved most interesting. The film showed no trace of a crater, and the stomach and jejunum were well outlined with barium. Of particular interest was the demonstration of retrograde passage of barium through the duodenum, the pylorus, and into the antrum of the stomach, which was left at the first operation.

The increased incidence of gastrojejunal ulcer following gastric resection in which the antral mucosa is not removed has been explained by the fact that the mucosa makes possible the continued excessive secretion of gastric juice, presumably through the elaboration of gastrin, as called for in the hypothesis of Edkins. The work of Edkins, however, indicated that gastrin is liberated from the antral mucosa only on contact with food. In the case reported we have visual evidence that a retrograde passage of gastric contents through the duodenum, through the pylorus, and into the antrum can occur, fulfilling the requirements for liberation of gastrin and its stimulating action on the gastric glands. It is significant, therefore, that in this patient a large jejunal ulcer healed following complete vagus section, even though that part of the humoral mechanism for gastric secretion controlled by the antral mucosa was still present.

Perforation of the Small Intestine by the Miller-Abbott Tube. Louis Berger and Samuel Achs. Surgery 22: 648–656, October 1947.

After discussing the indications and contraindications for the use of the Miller-Abbott tube and the complications attending its use, as reported by others, the authors present a case illustrating a further type of complication, namely perforation of the small intestine.

The case was one of mechanical intestinal obstruction due to postoperative adhesions. The Miller-Abbott tube controlled the distention for almost a week, after

which drainage from the tube diminished and finally ceased, as the patient's condition grew steadily worse. Operation on the twelfth day after insertion of the tube showed the tip distal to the balloon protruding through the small bowel wall into the peritoneal cavity, just proximal to the point of obstruction. The tube was withdrawn sufficiently to place the tip within the intestine and the perforation was closed. Lysis of adhesions was done, and the tube was left in place for one day longer. Recovery was uneventful.

The authors emphasize the danger of complications occurring specifically as a result of continuous pressure of the tube in one area, of which their case is a dramatic example. They point out that prolonged intubation should be accompanied by frequent roentgenographic or fluoroscopic observations to check the position of the tube.   J. E. WHITELEATHER, M.D.

Henoch's Purpura:—A Case with Bullous Skin Lesions and Residual Scars, Roentgenologic Considerations. Manfred Kraemer. Gastroenterology 9: 608-611, November 1947.

This is a brief report of a case of Henoch's purpura developing shortly after ingestion of a tunafish sandwich. The immediate symptoms were diarrhea and abdominal cramps, followed by the appearance of large painful bullae on the legs and feet. Typical hemorrhagic lesions appeared on both buttocks. The bullae on the extremities were hemorrhagic at their bases and exuded a serous fluid. Sloughing of the surface layers eventually occurred, leaving granulating ulcers which healed slowly with permanent scarring. Radiologically the case was of interest for the abnormal small bowel pattern, with a loss of the normal rugal folds in the jejunum and segmentation and clumping of the barium in the ileum. This is the second reported case in which these intestinal changes have been demonstrated (see Whitmore and Peterson: Radiology 46: 373, 1946).

EVERETT L. PIRKEY, M.D.

X-Ray Demonstrable Lesions of the Colon. Fred Jenner Hodges. Illinois M. J. 92: 279-282, November 1947.

This is a paper presented before a general medical assembly emphasizing the value of a barium enema study of the colon. The author cites the experience of his own Department of Roentgenology with 10,703 patients referred for examination because of the possibility of some abnormality of the large bowel. Seventy-eight per cent of these were found to have no recognizable lesion of the colon. Diverticula were discovered in 7 per cent; some form of organic colitis was present and recognizable on the basis of anatomical alterations in 2 per cent; 3 per cent showed unmistakable evidence of a colonic neoplasm, while 2 per cent presented signs of intrinsic disease in which differentiation between primary neoplasm, secondary neoplastic invasion, and some form of inflammatory process could not be determined. The remainder of the series (8 per cent) showed a variety of miscellaneous conditions.

The author concludes that when x-ray examination of the colon is used widely, both in the face of leading symptoms and on suspicion, one may expect to encounter important intrinsic organic lesions in the order of once for every twelve patients examined.

GLENN F. MILLER, M.D.

Volvulus of the Sigmoid Colon and Its Treatment. Christian Bruusgaard. Surgery 22: 466-478, September 1947.

This report is a study of treatment methods employed in cases of volvulus of the sigmoid colon admitted to the surgical departments of Ullevaal Hospital, Oslo, Norway, from 1936 to 1946. There were 168 admissions of 91 patients.

The factors which predispose to volvulus of the sigmoid are: (1) a long and freely movable sigmoid colon, (2) a long and freely movable mesosigmoid, (3) a rather narrow attachment of the mesosigmoid to the posterior abdominal wall. Any procedure which accomplishes detorsion but does not alter these factors is not definitive, and volvulus may recur.

The condition occurs most often after fifty years of age. More men than women are affected because the tighter abdominal wall and less roomy pelvis in men tends to prevent spontaneous detorsion.

The x-ray examination is of great importance in diagnosis and occasionally in treatment. The following roentgen features are listed:

(1) A more or less markedly distended sigmoid.
(2) Fluid levels in the sigmoid loop, little different in level in the upright position.
(3) Moderate gaseous and fluid distention of the remainder of the colon.
(4 and 5) Balloon-like distention of the cecum and gas in the small bowel rare, seen chiefly with peritonitis.
(6) Spiral patterns of the mucous membrane at the site of torsion when outlined by barium enema, but only when torsion is limited to a small segment.
(7) Thickened but smooth walls in the sigmoid flexure.
(8) Domes of the diaphragm high and almost rigid.
(9) Fluid in the peritoneal cavity, when the circulation to the torsioned loop is compromised.
(10) Signs of peritonitis in strangulation with gangrene, as suggested by fluid between the distended loops.
(11) Demonstration, by barium enema, of a characteristic outline of the part of the rectum near the obstruction—a "bird's bill shape" with spiral narrowing. The sharp luminal defect frequently seen in cancer is not seen in volvulus.

Spontaneous reposition of the volvulus occasionally occurs, or detorsion may follow an ordinary enema or a barium enema. Emptying the sigmoid flexure by insertion of a soft rubber tube past the site of the torsion is sometimes attended by good results. Intubation with proctoscopy is more easily carried out, and this is the routine method in the Ullevaal Hospital in cases without evidence of serious circulatory changes in the bowel either at the site of torsion or elsewhere. Through the proctoscope it is possible to form an idea as to whether circulatory embarrassment is present and, thus, whether there is danger of perforation by the rectal tube. This procedure was followed by satisfactory results in a total of 123 attempts in the period covered by the present study. One patient died as a result of perforation of the bowel and 3 died of causes unrelated to treatment. In 9 cases insertion of the tube proved to be impossible, and in these laparotomy was done.

In 2 cases, no treatment could be instituted as the patients were moribund upon admission.

The mortality rate for the entire series of 168 admissions was 7.7 per cent, and for the 91 patients, 14.2 per cent for all methods. For the cases treated by the rectal tube method, the figure was 2.9 per cent. Considering the age and condition of many of these patients, these results are excellent.

J. E. WHITELEATHER, M.D.

Mesenteric Thrombosis. Leo A. Harrington. Am. J. Roentgenol. **58:** 637–640, November 1947.

Four additional cases of mesenteric thrombosis showing distention of the large bowel in the distribution of the superior mesenteric vessels are presented. Distention does not always occur with mesenteric vascular occlusion, but the incidence is high enough that it should be borne in mind when reading the abdominal film on an emergency case. Like many another sign, if one does not think of it, the opportunity will be missed to make a good diagnosis, since it is the distribution of the distention that is important and not the degree.

The distention stops abruptly at or near the splenic flexure but small amounts of gas can be seen in the descending colon.   ZAC F. ENDRESS, M.D.

Difficulties in the Diagnosis and Treatment of Lesions of the Pyloric Antrum. Harry L. Segal, James S. Watson, Jr., and Theodore B. Steinhausen. New York State J. M. **47:** 2292–2298, Nov. 1, 1947.

The authors emphasize the importance of careful evaluation of changes in the pyloric antrum, with repeated examinations until a diagnosis can be reached. For practical purposes the differential diagnosis of antral lesions lies between carcinoma, benign ulcer, and such other benign lesions as antral gastritis and pylorospasm.

Nine cases are reported. Two of the patients had carcinoma; in 4 the changes were due to antral gastritis or abnormal rugae; in the remaining 3 the diagnoses were, respectively, pylorospasm on a psychogenic basis, pylorospasm secondary to a benign gastric lesion, and a pancreatic rest.

Gastroscopic examination proved to be very useful in those cases where the involved area could be adequately visualized. The laboratory findings alone were sometimes misleading and required evaluation in the light of the other observations. The importance of repeated x-ray examinations in the presence of persistent symptoms is stressed, as a single negative series does not rule out the possibility of cancer. When other methods fail to establish the cause of persistent or progressive changes, surgical exploration is indicated.

GLENN F. MILLER, M.D.

THE MUSCULOSKELETAL SYSTEM

Rheumatoid Spondylitis. David G. Pugh. Am. J. M. Sc. **214:** 568–576, November 1947.

A review of recent literature on rheumatoid spondylitis, under the heading Progress of Medical Science, leads the author to conclude that the symptoms are often misleading and, as a result, are frequently dismissed as unimportant or are attributed to some other disease. Roentgenologic manifestations of early rheu-

matoid spondylitis are often sufficiently definite so that their presence alone provides a diagnosis of that condition or confirms the clinical impression. Destructive changes in the sacroiliac joints are definitely indicative of rheumatoid spondylitis, especially when involvement is bilateral.

Brucellosis Osteomyelitis. Report of Two Cases in Which Shafts of the Long Bones Were Involved. George H. Lowe, Jr., and Paul R. Lipscomb. Surgery **22:** 525–529, September 1947.

Two cases of osteomyelitis due to infection with the Brucella group of organisms are reported.

One patient was a veterinarian who contracted a brucella infection in one arm in 1928, proved by cutaneous test several months later. In 1929, he had left hip pain without fever for one month. In 1930, an abscess of the right thigh was incised and continued to drain until the patient was seen by the authors in 1932. At that time he complained also of pain in the left hip, aggravated by activity or pressure over the area. Roentgen examination revealed osteomyelitis of the right femur and cystic areas in the right femoral neck and left acetabulum and ilium. Another right thigh abscess was drained and pus was obtained from the medullary canal of the femur. In 1933, a left posterior upper thigh abscess was drained. Roentgenograms then showed an additional area of osteomyelitis in the right parietal bone. Agglutination tests were positive in dilutions of 1:80, and cultures from the left thigh abscess yielded Brucella. Vaccines and sulfonamides were without effect on the lesions, and the latest communication from the patient, in 1940, stated that he was confined to his bed.

The second patient was a farmer, who was first seen with a left thigh abscess in 1945. The history indicates that he contracted brucellosis in 1925, and his health had been unsatisfactory since that year. His herd of cows was subject to a high abortion rate. The roentgenologic diagnosis was osteomyelitis of the lower part of the left femur. Agglutination tests were positive in dilutions of 1:80, and Brucella was cultured from the left thigh abscess. Therapy included drainage followed by penicillin and streptomycin. The patient improved for the next two years and was apparently well in 1947.

Pain in the long bones or the lumbar spine, and a history of recent and obscure fever should arouse suspicion of brucellosis osteomyelitis. In chronic osteomyelitis without drainage and with relatively little discomfort and disability brucellosis should also be suspected.

Agglutination titers may be within normal limits in long-standing cases and are of little value unless strongly positive. The pus is frequently cheesy, differing from that seen with the usual pyogenic organisms. Microscopically, the giant-cell reaction and irregular caseation may be confused with tuberculosis.

J. E. WHITELEATHER, M.D.

Report of a Case of Paget's Disease in an 18 Year Old Male, with a Review of the Literature. Marvin Wagner. Wisconsin M. J. **46:** 1098–1107, November 1947.

In a review of the literature, the author found no report of authenticated Paget's disease before the age of twenty-five. His patient was a soldier, aged eighteen at the time of discovery of the disease. He had sus-

tained a pathologic fracture of the humerus and the appearance of that bone stimulated further bone studies. There was evidence of involvement of the skull and left patella. The latter bone had been fractured two years previously and the author believes the disease was probably present at that time. Biopsy of this patella revealed the typical microscopic changes of Paget's disease. Follow-up examinations over a period of one year showed progressive involvement of the skull and early changes in the pelvis, femurs, tibiae, one great toe, the left humerus, and both patellae. The final diagnosis was generalized Paget's disease.

The etiology of Paget's disease, still undetermined, is discussed at considerable length. The author emphasizes the high incidence of involvement of the weight-bearing bones—sacrum, vertebrae, femur, and pelvis—as well as of the skull. The pathological description given is the classical one, as is also the discussion of the roentgen findings. The elevation of the serum alkaline-phosphatase level is noted as a valuable aid in differential diagnosis and an index of activity of the disease.

Although treatment is discussed, with mention of such methods as intravenous injection of calcium and magnesium, vitamin therapy, resection of the parathyroids, and administration of adrenocortical extract, no mention is made of therapy in the case reported.

The incidence of sarcomatous change in Paget's disease is given as 2 to 14 per cent. There was no evidence of the development of sarcoma in the patient studied so far as he was followed. At the end of the period of observation (ten months) he was not incapacitated and had very few symptoms.

BERNARD S. KALAVJIAN, M.D.

Testosterone Therapy in a Case of Fibrous Dysplasia of Bone with Hypogenitalism. Rita S. Finkler and George M. Cohn. Arch. Pediat. **64:** 567–578, November 1947.

In considering the treatment of fibrous dysplasia, the authors believed that, since the condition is usually more pronounced at earlier ages, the hastening of maturation might exert a favorable influence.

Their patient was first seen as a boy of nine, with numbness of the right hand and forearm and limitation of motion following a compound fracture of the right elbow. The roentgenogram of the healed fracture revealed a cystic appearance suggestive of osteitis fibrosa cystica. Further roentgen studies disclosed similar lesions in the skull, ribs, left humerus, both radii, ulnae and hands, both femora, right tibia and fibula, and the cervical and lumbar spine. The skull showed condensation in the occipital area, right maxillary and malar bones, and both supra-orbital margins. The bone changes proved to be progressive. There was also a gradual loss of vision in the right eye, and facial asymmetry and hypogenitalism were noted. The calcium-phosphorus metabolism was within normal limits. By combined studies of bone biopsy and roentgenograms a diagnosis of fibrous dysplasia was made.

The patient was given testosterone propionate, 25 mg. parenterally, three times weekly for three months, twice a week for six months, and once a week for the next three months; the total duration of therapy being thus one year. There was improvement in general vitality and in the genital development, and roentgen studies before the termination of therapy showed definite stabilization and condensation in the lesions above described.

A fuller report of the roentgen findings in this case was made by Furst and Shapiro in RADIOLOGY (**40:** 501, 1943). PERCY J. DELANO, M.D.

Etiology of Infantile Cortical Hyperostoses. Percy J. Delano and Craig D. Butler. Am. J. Roentgenol. **58:** 633–636, November 1947.

Another case of Caffey's "infantile cortical hyperostosis" is added to the literature, with some considerations of the etiology. The authors believe the condition to be a form of infectious osteoperiostitis. Their case followed a smallpox vaccination, which may or may not have played a part. At least it would be interesting for others who have seen such cases to look into the matter of vaccination. The symptoms and x-ray findings paralleled the febrile course, strongly suggesting an infectious etiology. Syphilis and the deficiency diseases were excluded by the clinical history and roentgen findings. ZAC F. ENDRESS, M.D.

Prenatal Bowing and Thickening of Tubular Bones, with Multiple Cutaneous Dimples in Arms and Legs: A Congenital Syndrome of Mechanical Origin. John Caffey. Am. J. Dis. Child. **74:** 543–562, November 1947.

Prenatal bowing and angulation of a single tubular bone or of a pair of tubular bones of the lower extremity have been previously described in a small number of cases. Included in the present report are the case histories of 3 infants, each of whom had congenital symmetrical bowing of the femoral and humeral shafts and similar but sometimes unpaired deformities of the shafts of the tibia, radius, and ulna.

In each case, the bowed diaphyseal segments in or near their medial third showed thickening of the cortical segment on the concave wall of the curve and thinning of the opposite cortical segment. The thickening was limited to the concave curve itself and was invariably directed inward. The caliber of the medullary cavity was correspondingly reduced. In 2 cases metaphyseal spurs developed on the medial aspect of opposing bones at the knees. Large symmetrical cutaneous dimples overlay the salient angles of the curves in several of the deformed bones.

Intra-uterine mechanical pressure and pressure atrophy of the fetal skin are offered as probable causative mechanisms. The similarity of bowed legs caused by rickets and Blount's tibial osteochondrosis is emphasized.

Many of the bony deformities disappeared with advancing age, especially in the upper extremities, but many were still present during the third year of life. All the neonatal dimples persisted during infancy without significant change as the children grew older.

JOSEPH C. FURNARI, M.D.

Benign Central Cartilaginous Tumors of Bone. Bradley L. Coley and Anthony J. Santoro. Surgery **22:** 411–423, September 1947.

This is a study of 22 cases of central chondroma of bone and 8 cases of benign chondroblastoma of bone.

The central chondromas, with a single exception, involved the long bones of the extremities. Symptoms are slight, and the lesion is often first brought to the patient's attention by a pathological fracture. While the roentgenologist can frequently make a strong presumptive diagnosis of a central chondroma on the basis

of a circumscribed area of radiolucency in the end of a long bone, it is often possible to confuse the picture with that presented by bone cyst, giant-cell tumor, and non-osteogenic fibroma of bone. Since, therefore, biopsy is necessary for diagnosis, and inasmuch as the purely chondromatous tumors are not radiosensitive, surgery is indicated. Not only is roentgen therapy ineffective, but it may make later surgery impractical. In only 2 of the authors' 22 cases was surgery followed by recurrence, and in both of these re-operation was successful. There were no postoperative complications in any case. Four patients received roentgen therapy. In 2 of these a mid-thigh amputation was required because of unsatisfactory results; in one case aspiration biopsy showed the development of sarcoma; the fourth patient had a rib resection after preoperative irradiation. Pathological examination should include all parts of the tumor, since there is a tendency toward sarcomatous change. Myxomatous changes have also been reported.

Benign chondroblastoma (Codman's epiphyseal chondromatous giant-cell tumor) is classified as a benign cartilaginous tumor rather than a giant-cell tumor. The usual symptoms are pain and swelling at the site of the lesion. Three of the authors' cases involved the femur, 2 the humerus, and 1 each the tibia, metacarpal, and the astragalus. The tumor is thought to arise in an epiphysis and to involve the metaphysis secondarily. Radiographically, these tumors may be difficult to distinguish from other benign lesions and from sarcoma.

Chondroblastic tumors may be more radiosensitive than chondromas, and roentgen therapy may prove adequate. However, since biopsy is necessary for diagnosis and surgical measures have proved satisfactory, operation is considered the method of choice. If removal is thorough, results are good.

J. E. WHITELEATHER, M.D.

Congenital Humeroradial Synostosis with Other Synostotic Anomalies. Leslie A. Lambert. J. Pediat. **31:** 573–577, November 1947.

A case of humeroradial synostosis, believed to be the twenty-sixth on record, is presented. The patient, a child of six months, showed numerous other bone and joint anomalies, including bowing of the upper third of the tibia on both sides and extensive, bilaterally symmetrical malformation of the digits of the hands and feet. Some points of etiology and frequency are briefly discussed.

Injuries to the Hip Joint. Traumatic Dislocations Incurred Chiefly in Jeep Accidents in World War II. Marshall R. Urist. Am. J. Surg. **74:** 586–597, November 1947.

This is the first of three papers in which an analysis of 58 cases of hip joint injuries incurred in World War II is presented, and the end-results are compared with the end-results of similar injuries in a civilian group from the Massachusetts General Hospital. The cases are divided into three groups: dislocations of the hip (15 cases), fracture of the acetabulum (16 cases), and fracture-dislocations of the hip (27 cases).

This first communication has to do with the 15 cases of dislocation of the hip, which were sustained chiefly in jeep accidents. Circumstantial evidence suggested that these dislocations were produced by a forceful blow

on the flexed knee or on the sole of the foot, transmitted through the extended knee, either alone or in combination with violent blows against the lower back and the lateral aspect of the hip. The jeep appears to provide the exact conditions which experimental observations have shown necessary for production of hip dislocations, *i.e.*, the passenger sits with the thighs acutely flexed, with the femoral head in internal rotation, directed posteriorly and therefore disposed toward posterior dislocation. The associated traumatic lesions were chiefly injuries to the soft parts of the joint. Roentgenographic evidence of an avulsion chip fracture of the rim in 3 cases suggested that the capsule was torn at its acetabular attachment. In 2 cases there was x-ray evidence of an avulsion fracture in the posterior intertrochanteric region, indicating a capsular tear at the femoral attachment.

In all cases reduction was accomplished, apparently without difficulty, by relatively inexperienced surgeons. The Allis, Bigelow, and Stimson methods of reduction were used. Stimson's method is the simplest and most gentle and was successful in most cases. Definitive treatment was traction (skin or skeletal) for from four to eight weeks, based on the fact that six weeks is regarded as optimal time for healing of the capsular tear. Weight bearing was avoided for from two to six months, with an average of three and a half months.

Nine of the patients were seen after two years, and a comparison of this group with 7 cases of hip dislocation taken from the fracture service of the Massachusetts General Hospital and followed for from two to seven years was made. This showed comparable results, though the 7 civilian cases were treated by short periods of immobilization, with early weight bearing, in contrast to the more extended periods of traction and restriction of weight bearing customary in military practice. After two years there were no cases of aseptic necrosis or degenerative arthritis in the military group and only one instance of aseptic necrosis among the civilians, in an adolescent boy.

The author concludes that restriction of weight bearing beyond six to eight weeks is not to be encouraged but advises close observation for any evidence of avascular necrosis.   D. B. NAGLE, M.D.

Tuberculosis of the Hip in Children, Certain Roentgenographic Manifestations, Secondary Changes in the Extremity, and Some Suggestions for a Program of Therapy. H. R. McCarroll and R. D. Heath. J. Bone & Joint Surg. **29:** 889–906, October 1947.

Tuberculosis of the hip in children is still a difficult problem. The authors have made a study of this manifestation of tuberculosis over an extensive period of time. The former procedure in handling these cases was prolonged immobilization of the hip in plaster, for anywhere from two to seven years, after which arthrodesis was done. When these patients reached maturity, however, the affected extremity was markedly shorter than that on the normal side. In order to obviate this deformity, the method of handling these cases was changed. Immobilization is now maintained for several months only, until the process becomes quiescent, when some method of arthrodesis is practised.

The authors have found the Brittain method of arthrodesis satisfactory. It offers a better prospect of maintaining the length of the extremity; good arthrodesis is obtained, and the over-all end result is superior.

The illustrations of this paper include a large number of roentgenograms. The roentgen findings are not discussed in any detail, but the authors state that in those of their cases in which the early osseous lesion could be determined, the cancellous bone on the acetabular side of the joint was more frequently involved than the metaphyseal region of the femoral neck. An occasional case with primary involvement in the latter location was encountered, however. Such lesions, although they may be slower in progression, usually result in the same massive destruction of the hip joint.

JOHN B. McANENY, M.D.

Influence of Hypervitaminosis A on Bone Growth. Thomas E. Van Metre, Jr. Bull. Johns Hopkins Hosp. **81:** 305–311, November 1947.

A study was made to determine the effect of hypervitaminosis A on the longitudinal growth of the long bones of the rat. Weanling rats of the Wistar strain, twenty-one days old at the beginning of the experiment, were given 250, 275, 625, or 1,250 international units of vitamin A per gram of body weight per day and the longitudinal growth of the left tibia was measured by taking weekly roentgenograms. The distance on the films between the midpoints of the proximal and distal ends of the bone was considered to represent the length of the bone. With the x-ray tube set at a target-film distance of 90 cm. to insure perpendicular rays, minor variations in the position of the leg inherent in this technic did not introduce an error of more than 0.1 mm. Alterations in the gross morphology of the tibia were followed by roentgenograms and observations of the bone at autopsy. The bones were found to be more slender than in normal controls. The cortex of the metaphysis was less opaque to the roentgen ray. The epiphyseal cartilage was decreased in width. Within the range of the dosage used, the greater the amount of vitamin A given, the more pronounced was the effect. The roentgenograms were taken too early to demonstrate fracture. Fracture was always observed, however, across the region of decreased density between the seventh and fourteenth day of treatment when 625 or 1,250 international units of vitamin A per gram of body weight were given, but only after the fourth week of treatment when 250 international units of vitamin A were given. The magnitude of change observed microscopically again was directly proportional to the amount of vitamin A administered.

The author concludes that it is possible to have accelerated remodelling of bone which is secondary to no readily appreciable increase in the stress and strain operating in and on that bone.

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography in the Treatment of Sterility in the Female. Charles L. Martin and John J. Sazama, Jr. Texas State J. Med. **43:** 389–393, October 1947.

The authors use carbon-dioxide insufflation and lipiodol injection for hysterosalpingography, doing the test on the seventh or eighth day after menstruation—just prior to ovulation. A cleansing enema and emptying of the bladder are the only necessary preparations.

The vaginal vault having been prepared, the rubber-tipped cannula is fitted into the external os and held by a tenaculum grasping the cervix. Under known pressure and volume control, the gas is allowed to enter the uterus. The rate of flow is about 60 c.c. per minute and the pressure is not allowed to exceed 200 mm. of mercury.

Normal patency is established at pressures from 80 to 120 mm. of mercury. A permeable obstruction is indicated by passage of gas into the peritoneal cavity at pressure above 120 mm. of mercury; spastic obstruction is usually preceded by a rise to about 150 mm. After about 500 c.c. of carbon dioxide has flowed in, the instruments are removed, the patient is turned into the prone position, and the head of the table is lowered so that the gas will collect about the pelvic organs. The radiographs are then made.

If no gas can be forced through the fallopian tubes, the rubber tubing of the carbon-dioxide apparatus is replaced by a Luer syringe containing 10 c.c. of lipiodol. Five cubic centimeters of the oil is injected, and a radiograph is made and immediately processed. Usually this film will show no oil passing completely through the tubes. Another 2 c.c. of oil is then injected and another film made, and the process is repeated until oil is seen free in the peritoneal cavity or until it is obvious that no further progress is being made. It is imperative that the pressure be maintained throughout by closing the valve on the cannula between injections. A final film is made twenty-four hours later, which often shows patency not definite before.

The test should not be carried out when there is acute tubal infection, during menstruation, shortly after curettage, or in patients with cardiovascular, pulmonary, or other serious systemic disease.

Of 293 patients examined, patency of at least one tube was established in 224, or 72 per cent. The authors were subsequently able to reach 169 of these by mail, and 72 (42 per cent) reported subsequent pregnancies, most of them within six months of treatment. Most of these patients had been sterile three years or longer. Forty-five per cent of 37 women with dysmenorrhea reported marked improvement following the test. No serious sequelae were observed.

BERNARD S. KALAVJIAN, M.D.

Value of X-Ray Studies of the Pelvis in Obstetrics. O. Hunter Jones. Am. J. Obst. & Gynec. **54:** 776–782, November 1947.

Questionnaires were sent to members of the South Atlantic Association of Obstetricians and Gynecologists in an effort to determine the frequency with which pelvic x-ray studies are done in obstetrics, the technics employed, and the value derived from them. Ninety-three replies are analyzed.

Three of those replying used x-rays rarely, if ever. In other replies the percentage of cases thus studied showed a range from 1 to 100 per cent. The percentage was given as between 1 and 10 in 73 per cent of the replies, and twice as many made x-ray studies in 1 to 5 per cent as in 6 to 10 per cent. Most of the studies were made near or at term and, less frequently, during labor.

Of the 93 obstetricians, 45 employed the Thoms-Torpin technic; 13 the Ball technic; 7 the Caldwell-Moloy technic, and the rest a variety of technical procedures. Many were dissatisfied with the particular methods they were using. The author uses the Caldwell-Moloy technic and seems to be fairly well satisfied with the results.

About one-third of the group regarded x-ray studies as of real value, but only 50 per cent of these used x-ray

as an important part of obstetrical management. About one-third showed only a mild interest in such studies. The remaining one-third found them of little, if any, value. Questionnaires from six or seven medical schools located in the area indicated that not all of them were stressing the value of pelvic roentgenography to medical students or to the house staff.

The author believes that x-ray studies may confirm clinical findings and reveal pelvic features undetected by vaginal examination. Pelvic radiography does not increase the incidence of cesarean section, but it certainly aids in the application of cesarean section to the proper cases.   WILLIS MANGES, M.D.

THE GENITO-URINARY SYSTEM

Ureteral Diverticulum: Classification of the Literature and Report of an Authentic Case. Ormond S. Culp. J. Urol. **58**: 309–321, November 1947.

Fifty-two cases have been reported in the literature as ureteral diverticula. The author found 13 of these to be hydronephroses, ureteroceles, or vesical diverticula. The remaining 39 cases he segregated into three groups. Group I consists of 14 cases of blind-ending branches of bifid ureters. These hollow structures have a lumen which joins that of the ureter at an acute angle and a wall that contains all of the ureteral coats; their length is more than twice their greatest diameter. Group II consists of 10 cases of segmental hydroureter. This condition the author defines as any ovoid, round, or spindle-shaped dilatation that has the ureter draining into the upper end, communicates with the bladder through the dependent portion, lacks a solitary stoma, presents all of the ureteral coats, and in reality is a segment of the affected ureter. These appeared to be secondary to strictures of the lower end of the ureter. Group III consists of 15 cases to which the author would confine the designation ureteral diverticulum. Ten of these were true congenital diverticula and 5 were acquired, being secondary to strictures, calculi, and trauma.

The true ureteral diverticula he defines as ovoid or round extra-ureteral sacs which contain all of the ureteral coats, communicate with the ureteral lumen through a distinct stoma and are congenital in origin. They vary in size and position, occur in both sexes and on either side of the body, present no pathognomonic symptoms, sometimes contain calculi, usually result in some degree of hydronephrosis and urinary tract infection, may be recognized by retrograde instrumentation, and usually require surgical removal. Operation may include reimplantation of the ureter in the bladder, end-to-end anastomosis of the ureter, or nephroureterectomy, depending on the site of the diverticulum, the size of the stoma, and the associated pathology.

Acquired ureteral diverticulum is a misnomer. Most commonly it is (1) a localized extravasation of urine at the site of a previous ureterolithotomy, (2) the result of accidental trauma, or (3) a so-called blow-out in the ureteral wall produced by calculi and/or strictures. Some of the ureteral coats are lacking, and infection is invariably present. Treatment usually is directed to correction of the ureteral obstruction.

The congenital diverticula evidently are the result of multiple budding or premature cleavage of the ureteral bud and, while similar to blind-ending bifid ureters in this respect, they become greatly dilated sacs instead of incomplete ureters.

An additional case of what appears to be a true congenital diverticulum of the ureter is presented. It had a capacity of 1,600 c.c., was not diagnosed preoperatively, and required nephrectomy because of severe associated hydronephrosis.   JOHN W. HOPE, M.D.

Diverticulum of the Ureter: A Review of the Literature and a Report of Two Additional Cases. John G. Pratt, Harry Q. Gahagan, and J. L. Fischman. J. Urol. **58**: 322–326, November 1947.

In a review of the literature the authors found a total of 34 reported cases of diverticula of the ureter. [See, however, preceding Abstract]. They report 2 additional cases of their own. In one the diverticulum developed at the site of a scar from a previous ureterolithotomy. It was demonstrated roentgenographically and was seen to contain a large calculus which had given rise to severe clinical symptoms. These subsided after a diverticulectomy. A follow-up eight months later showed a recurrence of the diverticulum without calculus formation. The second case was inadequately studied, as the patient left the hospital. Pyelograms showed dilatation of the right kidney pelvis and the ureteral catheter "coiled in a diverticulum on the left side of the bladder at or near the ureteral opening." Anteroposterior and left oblique cystograms showed no filling defects or diverticula of the bladder.

The records of the Charity Hospital of Louisiana, from which this report comes, showed only one other x-ray report of a ureteral diverticulum.
          RICHARD C. RIPPLE, M.D.

Vesical Diverticula: A Congenital Study with Special Reference to Treatment. Harry M. Spence and Sydney S. Baird. J. Urol. **58**: 327–343, November 1947.

The authors have analyzed 35 cases of vesical diverticula in order to arrive at an optimal method of treatment. The formation of diverticula is due to some type of interference with bladder emptying, including, in this series, adenomatous hypertrophy of the prostate, fibrous contracture of the bladder neck, urethral stricture, neurogenic dysfunction, and congenital valves. The diagnosis of diverticulum is made by detecting the orifices cystoscopically or by roentgenography, with either air or an opaque medium for the cystogram. Oblique films, as well as an anteroposterior view, are helpful. Excretory urography not infrequently demonstrates an unsuspected diverticulum, but is not to be considered a substitute for the conventional cystogram. The size and location of the sac, its relation to the ureters, changes in the bladder neck, residual urine, and presence or absence of infection are points to be noted.

The authors' cases are divided into three groups: Group I included cases with no treatment or with palliative treatment only, including urethral dilatation and elimination of infection; Group II included those cases in which transurethral resection of the bladder neck obstruction was done; in Group III diverticulectomy was performed, together with appropriate surgery for relieving the obstruction. The diverticulectomy technic was a modification of that described by Barnes and Pearson.

The authors conclude that whenever retention in a diverticulum can be demonstrated, regardless of the size of the sac, diverticulectomy should be performed as a primary procedure. Surgical correction of the bladder neck obstruction should follow after a short interval.
          D. B. NAGLE, M.D.

Congenital Diverticulum of the Male Urethra. W. Graham Knox. J. Urol. **58**: 344–348, November 1947.

Congenital diverticulum of the male urethra is a rare condition which may be asymptomatic for many years. Clinical symptoms, when they do occur, result from secondary inflammatory changes arising from stasis in the diverticulum. These lesions are confined mostly to the anterior or pendulous urethra and are true diverticula, with a mucosa and a basement membrane. The several theories of origin are briefly reviewed by the author.

A case history is presented. The patient was a boy of 18 with a two-month history of incontinence of 10 to 15 c.c. of urine fifteen to twenty minutes post-micturition. Urinalysis showed 8 to 10 red blood cells per high power field as the only abnormality. Physical and cystoscopic examinations were negative, as were an intravenous urogram and a cystogram. Urethrograms revealed dilatation of the proximal third of the pendulous urethra and a combined cystourethrogram with exposures made during micturition revealed filling of a diverticulum. A first operation designed to obliterate the diverticulum by plications of the bulbo-cavernous muscle over the defect was unsuccessful. The diverticulum was then successfully excised.

D. B. NAGLE, M.D.

THE BLOOD VESSELS

Differentiation of Mediastinal Tumor and Aneurysm by Angiocardiography. Marcy L. Sussman. Am. J. Roentgenol. **58**: 584–589, November 1947.

The author shows that by angiocardiography it is possible to be much more definite in the diagnosis of mediastinal lesions than with conventional roentgen methods. A tumor can be easily differentiated from an aorta filled with contrast medium. Aneurysms practically always fill, along with their vessels of origin, but even when they do not, the aorta and/or pulmonary artery can be seen to be grossly irregular and tortuous, lending indirect evidence of aortic disease. A number of illustrative cases are presented with reproductions of plain films and angiocardiograms.

ZAC F. ENDRESS, M.D.

Abdominal Arteriography. Technique and Diagnostic Application. Frederick B. Wagner, Jr., Alison H. Price, and Paul C. Swenson. Am. J. Roentgenol. **58**: 591–598, November 1947.

The authors present a practical technic for abdominal aortography which requires a minimum of special equipment. This was employed without untoward sequelae in 26 consecutive cases.

The patient is lightly anesthetized with sodium pentothal on the x-ray table. After the skin is prepared and draped the surgeon makes the puncture, using a special needle (18 gauge) 15 cm. long. A malleable needle is used to minimize trauma to the aorta. The site of injection is just below the twelfth rib, four fingers' breadth to the left of the mid-line. The needle with the stilet is directed anteriorly, medially, and cephalically until bone is encountered. It is then withdrawn a little and directed more laterally. The stilet is removed and the needle advanced cautiously the remaining distance. A snapping sensation is felt as the needle enters the aorta, similar to that felt when a spinal needle pierces the dura, and a pulsating drip of blood appears (no

actual spurting), after which the needle is advanced 0.5 cm. into the lumen.

Two feet of rubber tubing is attached to the needle and, after a test injection of sterile saline solution, 10 c.c. of sodium iodide is rapidly injected. The organic iodides cannot be injected rapidly enough through the tubing and long needle to give a sufficiently high concentration. The roentgenogram is taken as the final 1 or 2 c.c. of the solution is leaving the syringe.

The celiac axis and branches are best seen when the puncture is performed at the level of the twelfth dorsal vertebra, as described above. Injection for demonstration of the renal arteries is best made at the level of the first lumbar and for the lower aorta and iliacs at the second or third lumbar. At the lower levels it is necessary to enter the skin six fingers' breadth from the spinous processes.

A number of illustrative films are reproduced showing the pictures at different levels. Indications for the procedure in cases of aneurysm, aortic occlusion, peripheral vascular disease, abdominal tumors, hypertension, and hydronephrosis associated with an aberrant renal vessel are discussed. ZAC F. ENDRESS, M.D.

Abdominal Venography. Pedro L. Fariñas. Am. J. Roentgenol. **58**: 599–602, November 1947.

The technic of venography of the inferior vena cava and iliac veins is described. Under local anesthesia the long saphenous vein is exposed by a short incision at the inner portion of the middle third of the thigh. A tourniquet is placed at the groin to make the vein more prominent. The vein is then punctured with a small trocar, the tourniquet is released, and 40 c.c. of diodrast is rapidly and continuously injected. (Sometimes direct puncture of this vein is possible without previous exposure.) Two 14 × 17-inch films are taken, the first when 30 to 35 c.c. of the opaque medium has been injected and the second immediately afterwards. This is accomplished by using a fast plate changer. Urograms may then be taken. Compression of the epigastrium with an inflated balloon will create a transitory hypertension in the region of the inferior vena cava, thus making visible some of its branches.

Except for the incision, the procedure offers no more dangers or discomfort to the patient than does intravenous urography. Indications for its use are more or less definite: (1) cases where there is a possibility of obstruction or thrombosis of the inferior vena cava; (2) tumors of the abdomen, especially renal neoplasms requiring intravenous urography; (3) liver conditions that lead to a portal hypertension with possibility of a portal vein-vena cava anastomosis.

TECHNIC

A Simple Encephalography Stand for Attachment to X-Ray Table. William Beecher Scoville. J. Neurosurg. **4**: 547–548, November 1947.

A simple stand for facilitating encephalographic examination is pictured. This stand (1) can be quickly attached to and removed from a standard x-ray table; (2) gives support of both head and trunk with an adequate airway; (3) facilitates pentothal administration; (4) permits easy change from the vertical to the horizontal position on the x-ray table, and (5) permits the taking of an upright lateral test film during injection of oxygen.

RADIOTHERAPY

NEOPLASMS

Role of Pinealomas in the Causation of Diabetes Insipidus. Gilbert Horrax. Ann. Surg. **126:** 725–737, November 1947.

It has been realized only recently that pinealomas are frequently associated with diabetes insipidus (Stringer, S. W.: Yale J. Biol. & Med. **6:** 375, 1934; Martin, J., and Davis, L.: Arch. Int. Med. **67:** 1119, 1941). Horrax reports 17 cases of pinealoma diagnosed during a fourteen-year period, associated with 5 of which there was well marked diabetes insipidus. The tumor was proved histologically in 2 of these cases; in the other 3 it was demonstrated by ventriculography. In one case the ventriculogram showed dilated ventricles, a large calcification in the pineal region, and the curved shadow of the tumor bulging into the third ventricle. In the other cases the shadow of the tumor could be seen encroaching upon the third ventricle.

Four of the 5 cases received roentgen treatment. In one of these, irradiation followed operative removal of the tumor, 12,000 r being given "through several ports directed toward the suprasellar region." This patient is now alive and well more than five years later, with polyuria greatly lessened. In a second case, radiation therapy only was given: ten treatments through two portals over a period of one month, totaling 1,750 r to each portal. In the other 2 cases roentgen irradiation followed surgical decompression. One received 2,700 r through three portals and one received five series of 1,500 r each over a period of eighteen months (750 r through each of two portals, totaling 1,500 r per series). These 3 patients have remained in good general condition for periods of six to fourteen years. In one of the group diabetes insipidus developed nine years after decompression and the initial irradiation. Further roentgen therapy had little effect on the urinary symptoms. In the other 2 cases, symptoms of diabetes insipidus, present at the time of original treatment, have shown considerable improvement. The author points out that in cases of this type it is possible that the water imbalance may persist because partial interruption of the nerve tract from hypothalamus to pituitary is permanent even though the tumor cells originally causing this interruption have been destroyed by the roentgen rays.

No technical factors are given for radiation therapy.
STANLEY H. MACHT, M.D.

Carcinoma of the Larynx. Methods and Results of Treatment. Gordon B. New, Frederick A. Figi, Fred Z. Havens, and John B. Erich. Surg., Gynec. & Obst. **85:** 623–629, November 1947.

This presentation is based on a study of 568 patients who were treated for malignant laryngeal neoplasms at the Mayo Clinic during a ten-year period, 1934 to 1943, inclusive. The following procedures are used: (1) thyrotomy and surgical removal of the growth; (2) laryngectomy; (3) removal or treatment of the local lesion under suspension laryngoscopy; (4) external irradiation. The selection of the most suitable method in each individual case is based on four factors: (1) size, location, and extent of the laryngeal growth, (2) grade of malignancy, (3) presence or absence of extralaryngeal extensions or metastasis to the cervical nodes, and

(4) age and general physical condition of the patient. The tumors are graded histologically from 1 to 4 according to the degree of malignancy.

Tumors of Grades 1 and 2, and usually Grade 3 carcinomas which have not metastasized, are believed to be more successfully treated by operation, while in Grade 4 irradiation is considered the treatment of choice. About 93 per cent of the cases seen at the Clinic were of Grades 1, 2, and 3 and hence, most were treated by surgical measures. Of the group reported here, 446 or 78.5 per cent, were treated surgically, as follows: 213 by laryngectomy; 184 by thyrotomy; 49 by suspension laryngoscopy, with surgical diathermy or radon seed implantation. Of all patients who underwent operation and who could be traced, 73.5 per cent survived five years or more without recurrence.

The remaining 122 patients, or 21.5 per cent, received external irradiation. Highly malignant lesions of limited extent involving the epiglottis, base of tongue, and occasionally the post cricoid region were often successfully treated under suspension laryngoscopy by implantation of radon seeds and supplementary external roentgen therapy. Of the traced patients who were treated by irradiation, 6.9 per cent lived five or more years after operation; of these patients, 46 per cent underwent preliminary tracheotomy. It is pointed out that since nearly all of these patients had inoperable lesions and were thought to be hopeless when first seen, this low survival rate is to be expected and should not be considered as an indication of the therapeutic value of irradiation in the treatment of carcinoma of the larynx.   J. H. FREED, M.D.

Two Cases of Cystic Lymphangioma of the Neck with Mediastinal Involvement. Folke Jacobsson. Acta radiol. **28:** 705–714, Nov. 13, 1947.

Two cases of cystic lymphangioma of the left side of the neck with mediastinal involvement are presented. Both patients were boys, and in both the tumor had been apparent since birth. The diagnosis was verified in each instance by biopsy. In one case, the cervical portion of the tumor was surgically removed, with good result. Otherwise the tumors were considered inoperable.

In treating cystic lymphangiomas of the neck with mediastinal involvement, surgery has to be weighed against roentgen irradiation. Even if the tumor can be completely removed, there is a great danger of postoperative infection and hemorrhage. On the other hand, radiotherapy has been little used. In the author's 2 cases, roentgen irradiation was given in series with rather small doses at long intervals, in accordance with Forssell's method of treating cavernous hemangiomas. The progressive diminution of the tumor is carefully observed and no further treatment is given as long as decrease in size continues. The results in both cases have been good, with no complications. The patients have been followed for about three years. There has been considerable reduction of the tumor in both cases, and both patients are in excellent condition.

Carcinoma of the Bronchus with Especial Reference to Its Treatment by Radiotherapy. L. M. Shorvon. Brit. J. Radiol. **20:** 443–449, November 1947.

To evaluate the effectiveness of radiotherapy in

patients with inoperable carcinoma of the bronchus, 213 cases treated between 1942 and 1946 are reviewed.

Seventy-five patients were too ill to receive treatment. The average duration of life in this group was six and a quarter months after the first symptom and forty days after the diagnosis was made. Twenty-three patients received palliative treatment only.

Postoperative irradiation was given in 4 cases. Two of the patients died, one twelve months and the other five months after operation. One was moribund seven months after operation. One was living and well three years and three months after treatment.

Irradiation in an attempt to accomplish cure was given to 111 patients. Of these, 28 were alive and well at the time of the report, one three years and the others for shorter periods (12 less than six months). Forty-three patients died in less than six months; 32 between six months and one year; and 8 after more than a year.

The author considers the possibility of cure of bronchial carcinoma by radiotherapy to be remote. Complete or marked relief of such symptoms as cough, dyspnea, and pain, however, was often obtained. Even though the patient's life was not materially prolonged, a period of relative comfort was obtained as a result of treatment.   SYDNEY J. HAWLEY, M.D.

Treatment of Cancer of the Breast by Curietherapy and Roentgen Therapy. J. Maisin. Acta radiol. 28: 593–610, Nov. 13, 1947 (in French).

The author presents the results obtained at the Cancer Institute of Louvain in the different types of mammary cancer over a fifteen-year period. The treatment employed was either irradiation exclusively or irradiation following the Halsted operation. Surgical results are shown to be greatly improved by postoperative irradiation. The percentage of five-year survivals for the combined treatment was 46.4 per cent. The outcome with irradiation alone—radium implants combined either with roentgen irradiation or teleradium—was as good as with irradiation and surgery: for 290 cases of Stage I and II (Steinthal), the five-year survival figure was 53.6 per cent. A high rate of survival may be obtained by submitting surgical recurrences to roentgen therapy. In few inoperable cases is there a survival of more than five years?

Results of Surgery and Radiation for Carcinoma of the Breast with Axillary Metastasis. K. W. Stenstrom and O. J. Baggenstoss. Acta radiol. 28: 623–632, Nov. 13, 1947.

A survival study was made of 110 patients with carcinoma of the breast who fulfilled the following criteria: A radical mastectomy had been performed at the University of Minnesota Hospitals. Postoperative roentgen therapy had been started within thirty-two days of surgery. Satisfactory records were available to show that the pathologist had definitely found metastatic involvement of axillary nodes. No distant metastases were definitely known to be present at the time of surgery. The patients had been treated between Jan. 1, 1927 and Dec. 31, 1941.

Of the 110 patients, 45 (41 per cent) survived five years or more; 37 of this number may be classified as "clinically cured" for five years while 8 were alive with recurrences. Twelve patients (22 per cent) lived ten years or more after the operation.

Radon seeds were used in 36 of the 110 cases, and radium needles in one case (1,960 mg. hr.). The amount of radon used varied from 1,267 to 4,360 mc. hr., but in the great majority of cases approximately 4,000 mc. hr. was employed. Only two cases were treated with radon after the middle of 1936. The radon seeds were implanted over the intercostal spaces and in the axilla, the exact location depending upon the surgeon's judgment. Of the 37 patients, 16 (43 per cent) survived five years or longer.

The majority of patients receiving roentgen therapy were treated from ten to fourteen days following radical mastectomy, and the following physical factors were employed: 200 kv.p., 30 ma., 0.5 mm. Cu and 1.0 mm. Al filter (h.v.l. 0.9 mm. Cu), focal skin distance 70 cm. During the period 1927 to August 1938, approximately 250 r (in air) was given every other day for four treatments (total about 1,000 r). This was directed to a field which included the anterior breast region, parasternal line medially, anterior supraclavicular cervical, and axillary regions. The series was to be repeated in about two months, but some patients did not co-operate in this respect. After 1928, additional treatments were administered to the axilla and the supraclavicular region. Of the 56 patients treated during this period, 21 (37.5 per cent) survived five years or longer.

From August 1938 through 1941, about 200 r (in air) was given every other day for six treatments (total 1,200 to 1,300 r) anteriorly to a field which included the above mentioned region. At the same time a treatment was directed posteriorly to the supraclavicular or axillary region, alternating these two fields with each anterior field. Three treatments of approximately 300 r (in air) each (total about 900 r) thus was administered to the supraclavicular and axillary regions in addition to what was given in the anterior field. A second series was not given under this plan. Of the 54 patients treated with this method, 24, or 44.4 per cent, survived five years or longer.

The technic used after 1941 is described in an article by Gratzek and Stenstrom (Radiology 44: 44, 1945).

Representative statistics published by surgeons since 1936 are included to demonstrate results from radical mastectomy alone and with postoperative irradiation for patients with axillary metastasis. They show that postoperative roentgen therapy has consistently contributed to improved results.

Cancer of the Cervix. Observation on the Effect of X-Ray Therapy on Regional Nodes. Langdon Parsons. S. Clin. North America 27: 1231–1239, October 1947.

The author reviews the previous types of therapy for cancer of the cervix, beginning before the advent of radium, when radical surgery of the pelvis was advocated by Wertheim. After radium came into use in 1918 to 1920, enthusiasm for its use was justified by an increase in over-all salvage from 14 to 20 per cent with no initial mortality. It soon became apparent, however, that while radium would effectively cure cancer of the cervix in a high percentage of cases when the disease was confined to the cervix, it was less effective when the parametrium and the regional nodes were involved. With the introduction of external roentgen radiation, initial enthusiasm was again borne out by a jump in five-year survival statistics from 20 to 35 per cent for the combined use of radium and x-ray.

Examining the possible explanations for failure to ob-

tain a higher percentage of salvage, the author mentions two possibilities: The existence of cases seemingly resistant to radiation is well known. The second possible explanation has to do with the effectiveness of x-ray therapy in dealing with extension to regional nodes deep to the surface of the skin, namely in the iliac and obturator areas. An increasing amount of evidence accumulates to bring the effectiveness of x-ray treatment for other than the local lesion under a serious cloud of doubt. In this connection mention is made of the recent work of Meigs in extending the radical Wertheim procedure to include intra-abdominal attack, as advocated by Taussig, and also of the method devised by Nathanson, still in an experimental stage, in which a surgical attack on the distant nodes is attempted after fair assurance that the local disease has been cured by irradiation.

Two cases are recorded which cast further doubt upon the effectiveness of deep x-ray therapy in lymph node involvement in the iliac, hypogastric, and obturator areas.

Case I: A 57-year-old woman had a Stage II carcinoma involving the entire cervix, with extension into the vaginal wall. After 7,200 r of x-ray therapy, eight 12.5-mg. platinum needles were inserted in the periphery of the growth and two 50-mg. radium tubes in the cervical canal. Three months later, when smear and biopsy were negative for cancer, the right side of a planned bilateral retroperitoneal node dissection was undertaken. The pathology reports indicated that the iliac nodes were replaced by tumor without the slightest evidence of radiation reaction. It is evident that these nodes lay beyond the scope of the radiation field. The immediately adjacent nodes in the hypogastric and obturator areas showed extensive radiation reaction along with tumor completely untouched within the nodes, which would indicate that these nodes, although within the field of irradiation, had not responded to treatment.

Case II: A woman aged 54 presented a Stage I lesion confined to the endocervix without clinical evidence of parametrial extension. On exploration, positive nodes were found throughout the obturator area, the external and common iliac areas, and growing into the hypogastric vein.

A course of 7,200 r of external irradiation was given, followed by 4,500 mg. hr. of radium. Six weeks later no local disease was apparent on vaginal smear and biopsy, and at two months a retroperitoneal node dissection was done on the side where the positive nodes had been found. Pathological studies of a resected node showed almost complete replacement by radiation fibrosis, but tumor cells showing no sign of radiation response were present.

The author concludes that while the place of retroperitoneal node dissection has not been finally evaluated, it would seem to be the logical approach in that it can be made to apply to the majority of cases.

CHARLES B. COBERN, M.D.

Radiation Treatment of Cancer of the Cervix. George Turner. Texas State J. Med. **43:** 452–456, November 1947.

In cancer of the cervix, radiation treatment must be applied according to a plan dictated by the grade, stage, and condition of the given case when examination is made.

The author uses two anterior, two lateral, and two posterior fields, 15 × 15 cm. each. A dose of 200 r is given through each of two fields every day and continued until the pelvis is encircled eight times, for a grand total external skin dose of 9,600 r. The factors are 250 kv.p., 15 ma., 50 cm. focal skin distance, and a Thoraeus III plus 1-mm. aluminum filter. To prevent radiation sickness, the patient is given 100 mg. of thiamine hydrochloride and 5 units of soluble liver extract intramuscularly following each fractional treatment.

On completion of the external treatment, the pelvic space is further irradiated through a vaginal approach, with a 2.5-cm. cavity cone and four transvaginal fields, none of which includes the cervix. A dose of 600 r is given each day through a single field, for a grand total of 4,800 r (1,200 r per field). The factors are the same as above except for the focal skin distance, which is 40 cm.

A double-cross arm cervical uterine radium applicator is next used. It is loaded with 100 mg. and delivers a dose ranging from 2,400 to 4,000 mg. hr., depending on the demands of the case.

Diligent follow-up care is observed following completion of therapy.

Of 26 patients treated in 1940–45, 14, or 54 per cent, were living; 12, or 46 per cent, had died. Twelve of 16 patients with lesions of Stages 1 and 2 were alive, and 2 of 4 patients with lesions of Stage 3. None of the patients with Stage 4 growths survived.

GLENN F. MILLER, M.D.

Optimum Dosage in the Treatment of Cancer of the Cervix by Radiation. Margaret C. Tod. Acta radiol. **28:** 564–575, Nov. 13, 1947.

A study of the effects of dose and time has been made in 1,601 cases of squamous carcinoma of the uterine cervix in Stages 1, 2, and 3 (old League of Nations staging) completely treated by radiotherapy. Of the total number of patients, 51 per cent survived three years.

Some patients were treated by radium alone, others by a combination of radium and roentgen rays. The cases treated by *radium alone* fall into the main groups:

A.1. Two applications of seventy-two hours each, interval one day, over-all time seven days.

A.2. The same as A.1., but with an interval of four days, over-all time ten days.

A.3. Three or four radium applications of forty-eight hours each given in an over-all period of about three weeks. This method was considerably varied, occasionally being completed in sixteen days and sometimes extended to twenty-four days.

Treatment by *radium in combination with roentgen radiation* falls into three groups:

B.1. Large field roentgen therapy to the whole pelvis followed immediately by a continuous radium application of six to seven days. Over-all time four weeks. The proportion of the dose obtained from external roentgen radiation was 30 per cent.

B.2. Three or four radium applications of forty-eight hours each with large-field roentgen therapy to the whole pelvis given after the first two radium applications and before the third. Over-all time five to six weeks according to the number of radium applications. Approximately 25 per cent of the dose was obtained from the external roentgen radiation.

B.3. Radium insertion to deliver a precalculated

dose in three applications of forty-eight hours each with a course of small-field beam-directed therapy to the parametria between the first two and the last radium application. Over-all time five to six weeks according to length of roentgen treatment. The proportion of the dose obtained from external roentgen radiation varied from 30 to 35 per cent.

A small number of patients was treated during the war years by two radium applications followed by a four-day course of small-field beam-directed roentgen therapy to the parametria.

The method of precalculating the dose makes use of the units system described in 1938 (Tod and Meredith: Brit. J. Radiol 11: 809, 1938). Special applicators, called ovoids, together with an intrauterine tube, are loaded with specified units of radium in a definite order. The number of units varies with the size of applicators which the vagina will admit, the range of width at the level of the external os varying from 2 to 10 cm. Dose is calculated at a point in the paracervical triangle which has been defined and designated point A. It is 2 cm. lateral to the central canal of the uterus and 2 cm. from the mucous membrane of the lateral fornix in the axis of the uterus. The use of the units system ensures that the dose from the uterine tube and vaginal applicators is balanced and that the dosage rate remains the same at point A regardless of the size of the applicators used. In this series of cases the range of dosage at point A available for assessment was from 6,000 to 12,000 r.

Eighty-eight cases were excluded from the investigation for various reasons. Conclusions based on the remaining 1,513 cases of cancer of the uterine cervix are as follows: If radium alone is used, the optimum dose level assessed at point A lies between 7,500 r and 8,000 r in seven days or 8,000 r and 8,500 r in ten days. The best results with radium alone in this series were obtained with 8,000 r in ten days. In patients over sixty-five the optimum dose appears to be 7,000 r in ten days. For radium plus small-field beam-directed roentgen therapy to parametria the optimum dose at four weeks is probably 9,500 r to 10,000 r and at five to six weeks 10,000 r to 10,500 r. The best results in this series were obtained with 10,000 r in six weeks, 7000 r gamma radiation plus 3,000 r roentgen radiation.

Treatment of Cervical Cancer. Ludwig Adler. Acta radiol. 28: 474–492, Nov. 13, 1947.

After a review of the history of surgery and radiotherapy in cervical cancer, the author describes the elective treatment of this disease, which he has used for twenty years: extended vaginal operation with immediate insertion of radium in most cases. Laparotomy with radium insertion is performed in patients unsuitable for the vaginal operation, and irradiation alone in inoperable cases and bad surgical risks. Permanent cures with the elective method amounted to 39 per cent.

Treatment of Carcinoma of the Cervix Complicated by Pregnancy. George Gray Ward. Acta radiol. 28: 576–582, Nov. 13, 1947.

During the past nineteen ears, among 36,274 obstetric admissions to the Woman's Hospital (New York), there have been 10 cases of malignant tumor of the cervix, 1 sarcoma, and 9 squamous-cell carcinomas. In 5 of the 10 cases, the tumor was discovered before the twenty-eighth week of pregnancy. Only one patient in this group lived for five years, and she died subsequently of cancer. In the group in which the fetus was viable, four babies and three mothers were salvaged; one case is recent; two women died within two years; one woman has lived over four years, and one seventeen years.

The author believes that irradiation of the cervix by radium and high-voltage roentgen rays associated with supracervical hysterectomy and bilateral salpingo-oophorectomy is the treatment of choice for carcinoma of the cervix complicated by pregnancy. In cases in which the fetus is non-viable, a supracervical hysterectomy should be done immediately, sacrificing the fetus, and irradiation should be instituted as soon as recovery warrants. In pregnancy at the sixth month, the cervix may be irradiated before hysterectomy in the hope of obtaining a living child. In all cases in which the fetus is viable, a Porro cesarean section should be done first, followed by radium application to the stump of the cervix and high-voltage roentgen therapy.

Clinical and Pathological Survey of Ovarian Tumours Treated at Radiumhemmet. I. Dysgerminomas. Lars Santesson. Acta radiol. 28: 644–668, Nov. 13, 1947.

This paper is the first part of a clinical and pathological survey of 700 cases of ovarian tumor treated at Radiumhemmet, Stockholm, to the end of 1940. It gives the data on 37 cases of pure dysgerminoma treated radiologically, for 27 of which five-year results are available. In addition, information on 192 cases assembled from the literature is reviewed. Only those cases are included which in all respects, and exclusively, show histologic structures typical of this rather rare type of ovarian tumor.

Of the entire group of 299 patients, 81 per cent were under thirty and 44 per cent under twenty years of age. In the 196 cases in which the location was mentioned, the tumor involved the right ovary in 51 per cent and was bilateral in 17 per cent. In 107 cases (80 from the literature and 27 from the Radiumhemmet material), the five-year survival rate is 51.4 per cent. For the 27 Radiumhemmet cases alone, the five-year survival rate was 66.7 per cent; the three-year survival rate based on 31 cases, 64.5 per cent.

In recent years there seems to be general agreement that radical surgical removal of the tumor, followed by radiotherapy, is the treatment of choice for dysgerminomas. There are, however, differences of opinion as to the necessary extent both of the operation and of the radiotherapy. Most authors believe that if at operation the tumor is found to be confined to one ovary, conservative surgery with radical excision only of the tumor is justified. From his review of the cases in the literature and the cases treated at the Radiumhemmet, the author concludes that a conservative surgical procedure is warranted only if it is followed by radical radiation, i.e., prophylactic radiation directed also to the uninvolved ovary. He states that such treatment, given in the right manner, does not impair ovarian function.

In the treatment of dysgerminoma, five fields have generally been used, including a central field against the upper part of the back up to the diaphragm. This field is of particular importance in the prophylactic roentgen treatment because these tumors at first metastasize chiefly to the retroperitoneal lymph nodes along the large abdominal vessels. The doses have varied from 400 to 600 r given in separate treatments of from 100 to

300 r, with 0.5-mm. copper as a filter. Over the field in the upper part of the back, doses have been somewhat smaller.

A comparison of the results in cases treated only by operation and those with both operation and irradiation was possible in only a limited number of patients. It shows about 20 per cent better five-year survival for the radiologically treated cases.

Malignant Teratomas and Some Remarks on Their Radiosensitivity. William Harris. Acta radiol. 28: 633–637, Nov. 13, 1947.

Since 1930, 6 patients with malignant teratoma of the ovary have been admitted to the Mt. Sinai Hospital (New York). The age range was from eight to fifty years; 4 patients were sixteen years of age or younger. The main symptom was abdominal enlargement over a period of several months to one year. The symptom requring hospitalization in all but one case was sudden severe lower abdominal pain, due in 3 instances to twisting and infarction of the tumor. An analysis of this small series of cases shows that any patient with malignant teratoma of the ovary which has spread beyond the primary focus will not survive, in spite of surgical removal and radiotherapy of the tumor. The prognosis even when the tumor is limited grossly to one ovary is not uniformly good. These tumors are considered among the most radioresistant. For this reason, most authors advise that young patients with limited unilateral lesions should rely on surgery only for cure, in order to avoid sterility and eunuchoidism. In older patients where sterility is not a factor, radiotherapy may be employed to advantage, but the amount of irradiation to be effective will have to closely approach normal tissue tolerance.

Twenty-Five Years of Radon Treatment of Cancer of the Bladder. Benjamin S. Barringer. J. A. M. A. 135: 616–618, Nov. 8, 1947.

The author reports 35.7 per cent five-year cures in 225 cases of cancer of the bladder treated by radium. In 113 cases in which tumors were graded pathologically there were in Grade 1, 55 per cent five-year cures; in Grade 2, 32 per cent; and in Grades 3 and 4 combined, only 11 per cent.

Early, ine act methods of application of radium to vesical tumors have been modified and standardized to a considerable degree, the current procedure of choice being implantation of screened radon seeds by means of needles, either through the cystoscope or a cystotomy wound. Whether cystoscopy or cystotomy is used depends on the experience of the urologist and the size and position of the tumor. In either case radon seeds, preferably of 1.5 mc., should be placed about 0.75 cm. apart; if the seeds are weaker, they should be closer together. They should go to the edge of the tumor and not beyond, and as deep as indicated by the extent of induration. This type of radium implantation is especially valuable in carcinomas or atypical papillomas of the lower part of the bladder situated near or on the trigone, ureteral orifices, or internal urethra. Tumors in which partial excision is indicated are those of the bladder vault, where operative removal is easy and practicable. Total cystectomy should be reserved for tumors which have many points of origin throughout the bladder.

The prognostic importance of carefully correlating the diagnosis given by pathologic study with the diagnosis as shown by clinical examination is stressed. For example, in this group of patients, if tumors graded according to pathologic examination are modified by the clinical estimate, there were 52 per cent five-year cures in papillary cancers and 23 per cent five-year cures in infiltrating cancers.   John F. Holt, M.D.

(University of Michigan)

Bone Changes and Variations in Skeletal Metastases Due to Diethylstilbestrol and Orchiectomy During Treatment of Cancer of the Prostate. Carl S. Wattenberg. J. Urol. 58: 378–383, November 1947.

Metastases in carcinoma of the prostate involve chiefly the pelvis, lumbar spine, and sacrum and are manifested for the most part by pain. Deep roentgen irradiation for palliation was formerly the accepted treatment. More recently it has been replaced by orchiectomy and estrogen therapy, which not only induces hyperossification, as demonstrated roentgenographically and microscopically, but also results in regression of both the primary and secondary neoplasms.   Horace G. Butler, M.D.

Malignant Tumours of the Testis. Treatment at Radiumhemmet, Stockholm. Hugo Ahlbom. Acta radiol. 28: 669–680, Nov. 13, 1947.

From 1922 to 1941, inclusive, 119 patients with malignant tumors of the testis were treated at the Radiumhemmet, Stockholm. The tumors were classified by the pathologist, Reuterwall, as: seminomas (65 cases), adenocarcinomas (24 cases), malignant mixed tumors (20 cases), and a group consisting of 10 malignant neoplasms of varying histologic structure, some sarcoma-like tumors and others with very low differentiation that could not be included in any of the first three groups. The average age of the patients in the last group was relatively high; the tumors were clinically highly malignant and the results of treatment rather poor.

Orchiectomy followed by roentgen therapy to the lymph nodes is the most effective method of treatment of seminoma and even of mixed tumors and adenocarcinoma. Routine irradiation of the mediastinum and the left supraclavicular region is not considered necessary. It is probably more important to give a rather large total dose to the para-aortic lymph nodes. The five-year survival rate for the entire series was about 50 per cent; in cases without metastases about 70 per cent. The seminomas alone showed a five-year survival rate of 65 per cent; in cases without metastases about 80 per cent. Fifteen of the 44 patients with adenocarcinoma and malignant mixed tumors (35 per cent) were alive and well at the end of five years.

Practically no information regarding prognosis was obtained from prolan tests in 59 cases. The blood sedimentation rate, however, seems to be of definite value. Most of the patients show a normal sedimentation rate when the primary tumor is removed and no metastases are present. If the sedimentation rate remains within normal limits during the next two or three years, the prognosis is favorable. If, on the other hand, there is a tendency toward gradually higher values, pain or other symptoms of metastases can be expected. In such cases the intervals between the follow-up visits are reduced in order to be able to give treatment at as early a stage as possible.

Results of Roentgen Treatment in Chronic Myel-ogenous Leukosis. Carl Krebs and Jørgen Bichel. Acta radiol. **28**: 697–704, Nov. 13, 1947.

During the past fifteen years, up to May 1946, 222 patients with various forms of leukosis were treated at the Radium Center in Aarhus. Fifty-eight had chronic myelogenous leukosis and it is with this group that the present paper is concerned. In evaluating the results of roentgen therapy the greatest difficulty was the lack of control material, since it is impossible to obtain data on non-irradiated or even untreated cases. The 58 non-irradiated (but not untreated) cases of Minot, Buck-man, and Isaacs are used for comparison (J. A. M. A. **82**: 1489, 1924. Abst. in Radiology **4**: 53, 1925).

All the patients except one were treated with roentgen rays. In the last few years, irradiation has been given to one or several fields of 10 × 10 cm. over the spleen, daily or every second day. Until the patient's in-dividual reaction is determined, only small doses, often no more than 25 r every second day, are given. The technical factors are: 160 kv., 4 ma., 1-mm. copper and 1-mm. aluminum filtration, distance 40 cm. While it is the patient's subjective symptoms which furnish the indication for irradiation, it is fully as much, or more, the hematologic findings which determine its discon-tinuance. In practically all cases it has been stopped long before the symptoms have fully disappeared. If treatment has been successful, it is interrupted when the leukocyte count has fallen to about one-third of the initial figure—though by preference not to below 50,000 per cubic millimeter—depending somewhat on how rapid the fall has been.

Of the 58 patients, 10 were alive at the end of the period covered by the present study. One died without having received roentgen therapy, and in 3 the data are incomplete. The average duration of life after the onset of the disease for the other 44 patients (23 males, 21 females) was 40.7 months. There is no essential difference, as regards the duration of life, in these ir-radiated patients and the non-irradiated patients of Minot, Buckman, and Isaacs. However, a comparison of the length of time the non-irradiated and irradiated patients remain "efficient" shows the enormous value of roentgen therapy. While the irradiated do not live very much longer than the non-irradiated, they enjoy during their remaining years a relative measure of well-being and capacity for work, in contrast to the non-irradiated, whose existence will always continue to be miserable.

Subarachnoid Cervical Angioma with Cutaneous Hemangioma of a Corresponding Metamere. Report of a Case and Review of the Literature. Glen O. Cross. Arch. Neurol. & Psychiat. **58**: 359–366, September 1947.

In adding this case report to five similar ones in the medical literature, the author again emphasizes the importance of recognizing cutaneous nevi as possible "external sign posts" (Cushing and Bailey) of under-lying vascular tumors of the spinal cord and vertebrae. The relationship of skin and spinal angiomas is such that the skin involvement may indicate precisely the location of the associated lesion of the cord.

The apparent close relationship of the various neuro-ectodermal syndromes (angiolipomatosis, hemangio-matosis including Sturge-Weber disease, Lindau's disease, and neurofibromatosis) is discussed. Radiation therapy may be employed successfully in certain in-stances of hemangioma of the spinal cord, but in most cases of congenital ectodermoses where there is cord compression, early surgical relief is imperative.

JOHN F. HOLT, M.D.
(University of Michigan)

NON-NEOPLASTIC DISEASE

Irradiation Treatment of Benign and Inflammatory Diseases of the Head and Neck. J. Francis Mahoney. M. Clin. North America **31**: 1538–1549, November 1947.

This article discusses the irradiation treatment of certain benign and inflammatory conditions of the head and neck (hemangioma, keloids, ringworm of the scalp, corneal scars and vascularization of corneal grafts, hypertrophy of nasopharyngeal lymphoid tissue). Its purpose is to call the attention of physicians to the use-fulness of irradiation in conditions other than cancer.

Roentgen and Vitamin A Therapy for the Treatment of Warts. A Comparison of the Two Methods and a Report of 315 Treated Cases. Samuel H. Fisher and W. Edward Chamberlain. Pennsylvania M. J. **51**: 151–155, November 1947.

X-ray therapy has long been considered safe and adequate for the treatment of warts. While the authors have not had any untoward effects from its use at Temple University from 1931 to 1945, there have been cases where attempted eradication by x-ray have re-sulted in serious ulcers. Most of the warts treated by the authors, as by the majority of radiologists, have been plantar warts.

The authors always treated as small an area as possible, protecting the adjacent skin with lead. They avoided repetition of treatment beyond a known safe dosage. The factors used were 86 kv., no added filter, h.v.l. 0.78-mm. Al. From 1,000 to 3,500 r was given in a single treatment, and 3,500 to over 5,000 r in three treatments. Experience, based on a series of 315 patients, indicated that a single dose of almost any value over 1,000 r was as good as an elaborate series of treatments. The over-all cure rate was 80.2 per cent.

One of the authors had a plantar wart which was treated by roentgen rays in 1929 and again in 1934 without success. For a number of years relief was ob-tained by the use of the callus file. A daily dose of 100,000 units of vitamin A taken orally caused the wart to disappear in three weeks. Because of this successful treatment, patients who presented themselves for treat-ment thereafter were instructed in the use of the callus file and vitamin A was prescribed—100,000 units per day. Treatment with the callus file and vitamin A has resulted in 35.6 per cent cures in a series of 42 patients. The duration of treatment in the successful cases ranged from five or six weeks to nine months.

JOSEPH T. DANZER, M.D.

Primary Actinomycosis of the Skin. Report of a Case. Emanuel Muskatblit. Arch. Dermat. & Syph. **56**: 706–712, November 1947.

A case of primary actinomycosis of the skin of the face in a 17-year-old girl is presented. The laboratory data indicated infection with *Actinomyces bovis*. Treatment with penicillin by intramuscular injections of 50,000 units every three hours for a total dosage of 10,000,000 units, followed by roentgen irradiation and administration of iodides, achieved an apparent clinical

cure. Eight roentgen treatments were given in the course of sixteen days but neither the total dosage nor the daily dose is stated.

Roentgen Therapy for Lymphoid Hyperplasia of the Nasopharynx. E. E. Seedorf and E. D. McKay. Texas State J. Med. 43: 457–461, November 1947.

Repeated upper respiratory infections frequently cause the lymphoid tissue of the nasopharynx to hypertrophy, sometimes forming such a mass as to cause complete obstruction of the orifice of the eustachian tube, leading to conduction deafness. This condition, either unilateral or bilateral, is frequently seen in children and is far more common than is appreciated in adults. Unlike perceptive or nerve deafness, this form is amenable to treatment.

Crowe and Baylor were the first to report (1939) the use of irradiation in the treatment of lymphoid hyperplasia of the nasopharynx. As it is the lymphoid tissue which is primarily concerned and this is the most radiosensitive of all the tissues, it is possible to give small enough doses to produce destruction of the lymphoid cells without undue injury to normal structures.

The authors believe that the question as to whether roentgen rays or radium is best adapted to the treatment of nasopharyngeal lymphoid hyperplasia is debatable. The radium applicator devised by Burnam and Crowe

makes it possible to irradiate this limited area without many rays penetrating distant tissues and also reduces the treatment time considerably, which is an advantage especially in young children. The use of roentgen rays usually leads to more dryness of the mouth, as a larger field is used, and a "roentgen parotitis" not uncommonly results for one or two days. Larger doses may cause temporary loss of hair or whiskers in the irradiated field. The authors' technic, using two lateral ports, 10 × 10 cm., 220 kv., 8 ma., 50 inch distance, 1 mm. copper plus 1 mm. aluminum filter, with h.v.l. of 1.49 mm. copper, and a dosage of 370 r, has reduced the above disadvantages considerably. They have used both x-rays and radium with equal results but prefer the former because of the ease of application. As most of their patients come from a distance, single treatments are generally given, but it is believed that smaller doses at intervals of a week to a month for several treatments are better tolerated and produce equally good if not better results.

In 1946 roentgen therapy was given to 53 patients, ranging from five to sixty-eight years of age. Questionnaires addressed to these were returned by 83 per cent and of that number approximately 70 per cent reported improvement following the therapy; in 87 per cent of these improvement was still maintained after three months to a year.   GLENN F. MILLER, M.D.

EFFECTS OF RADIATION

Surgical Treatment of Irradiation Dermatitis and Carcinoma. D. M. Glover. Am. J. Surg. 74: 735–746, November 1947.

The author classifies superficial irradiation injuries as (1) acute burns, (2) chronic dermatitis, and (3) chronic ulcers with malignant degeneration.

Acute burns are treated in much the same fashion as a burn of any etiology. Those involving a weight-bearing surface are the most difficult to treat, especially when associated with peripheral arteriosclerosis. Some plantar surface burns will heal in the young with bed rest, lack of weight bearing, and mechanical cleansing, and will remain healed if the plantar surface of the foot is padded to prevent pressure at the point of closure. Failure of healing following such conservative measures warrants further therapy in the form of excision and closure, excision and application of free grafts, or excision and application of a pedicle graft from the opposite leg. If the first of these forms of treatment fails, a free graft may be attempted, but few free grafts are permanently satisfactory on the sole. A pedicle graft from the opposite leg offers the most satisfactory results, but this is beset with disadvantages centering around immobilization in the aged, texture of the transplanted skin, and callosity formation at the operative site.

Chronic skin changes may follow promptly upon the healing of an acute irradiation burn or may develop many years after treatment. The skin shows a shiny, tense, mottled appearance, with many telangiectases and frequently areas of atrophy. Pruritus is quite usual with the passage of time, and pain may be severe in lesions undergoing malignant change.

Ulcers may persist for years before showing malignant alteration. The lesion may vary from a superficial

ulceration to a deep, penetrating ulcer with irregular margins and necrotic base. The usual malignant process proves to be of basal-cell type, but squamous varieties have been encountered. Basal-cell carcinoma is prone to occur in papules or multiple nodules which tend to coalesce and ulcerate superficially. There is a tendency to invade superficial fascial planes and extend beyond the area of skin involvement. Regional lymph node and disseminated metastases are rare. Radical surgical removal of the local lesions and the irradiated area offers a good prognosis. The author believes that the outlook in squamous-cell carcinoma arising in irradiated skin is somewhat better than in the basal-cell variety.

Prophylactic removal of ulcerated areas should be carried out, since the eventual incidence of malignant change may be rather high. The majority of the malignant lesions in the author's experience developed ten to-thirty-five years after irradiation. The prognosis of irradiation carcinoma of the skin should not be regarded as too serious. Radical surgical removal and replacement of the skin provide protection for a period of years in most instances; recurrences may still be arrested or cured if treated as radically as the initial lesion.

The author emphasizes that many lesions under his attention were the result of irradiation for benign processes. He does not believe that the use of radiation is to be discouraged under proper conditions and for proper indications, but he does suggest that "its use in the treatment of benign conditions which can be handled effectively by other means might be curtailed."

Eleven clinical histories are included, and the details of the surgical procedure involved in each particular form of repair are described.

      HORACE G. BUTLER, M.D.

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